

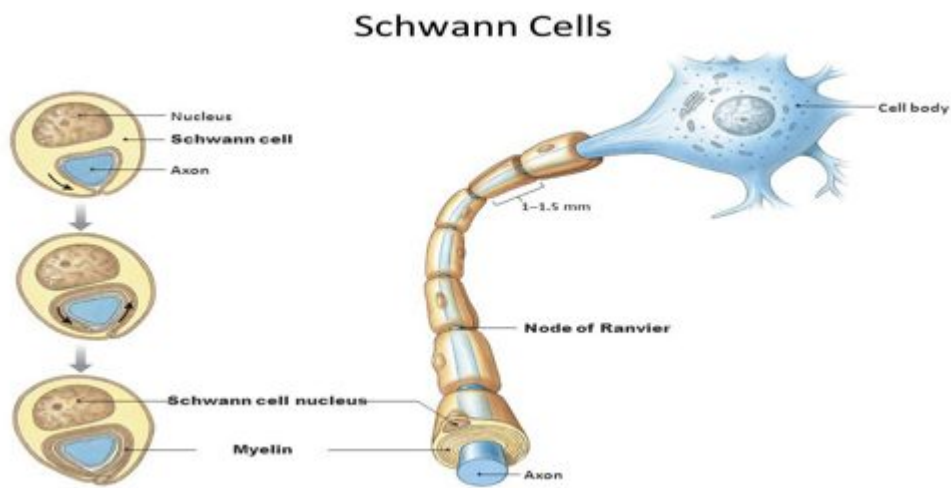
Akustikusneurinomer



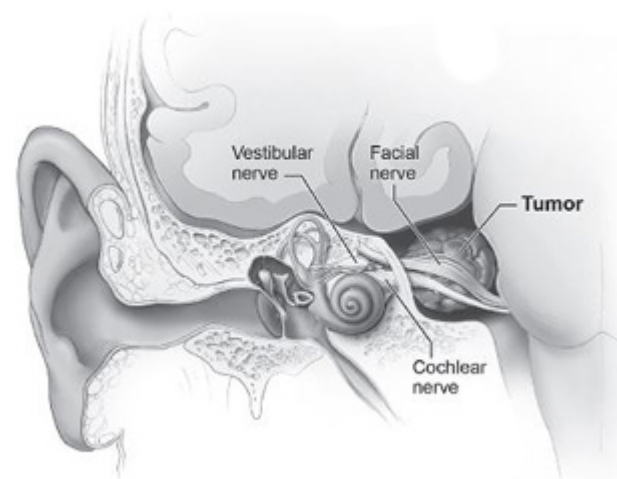
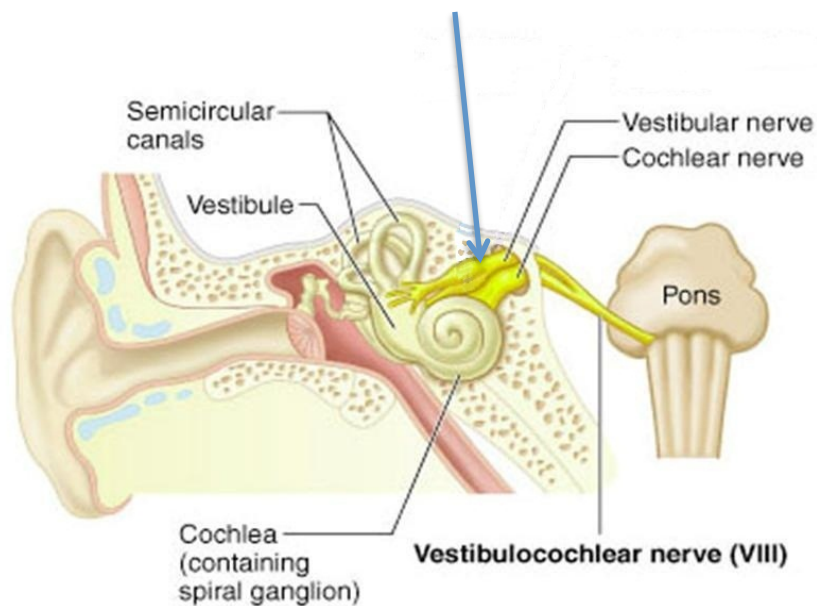
Kirurgisk behandling - før, nu og i fremtiden...

Jacob Springborg
Overlæge, klinisk lektor, phd

‘Schwannomer’ – godartede knuder udgået fra ‘nerveskeden’



Fra 'balancenerven' (nervus vestibularis) – en del af den 8. kranienerve

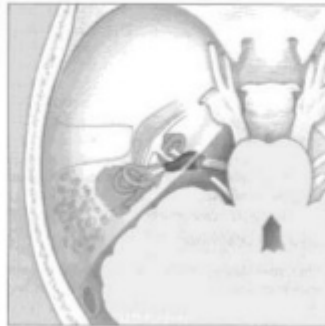


I Danmark godt 100 nye tilfælde pr. år

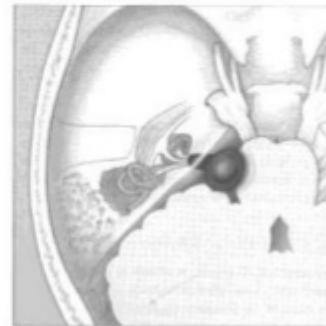
Typisk uden vækst, eller med langsom vækst

Phases of Tumor Growth

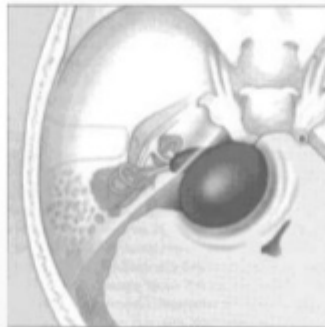
Intracanalicular



Cisternal



Compressive



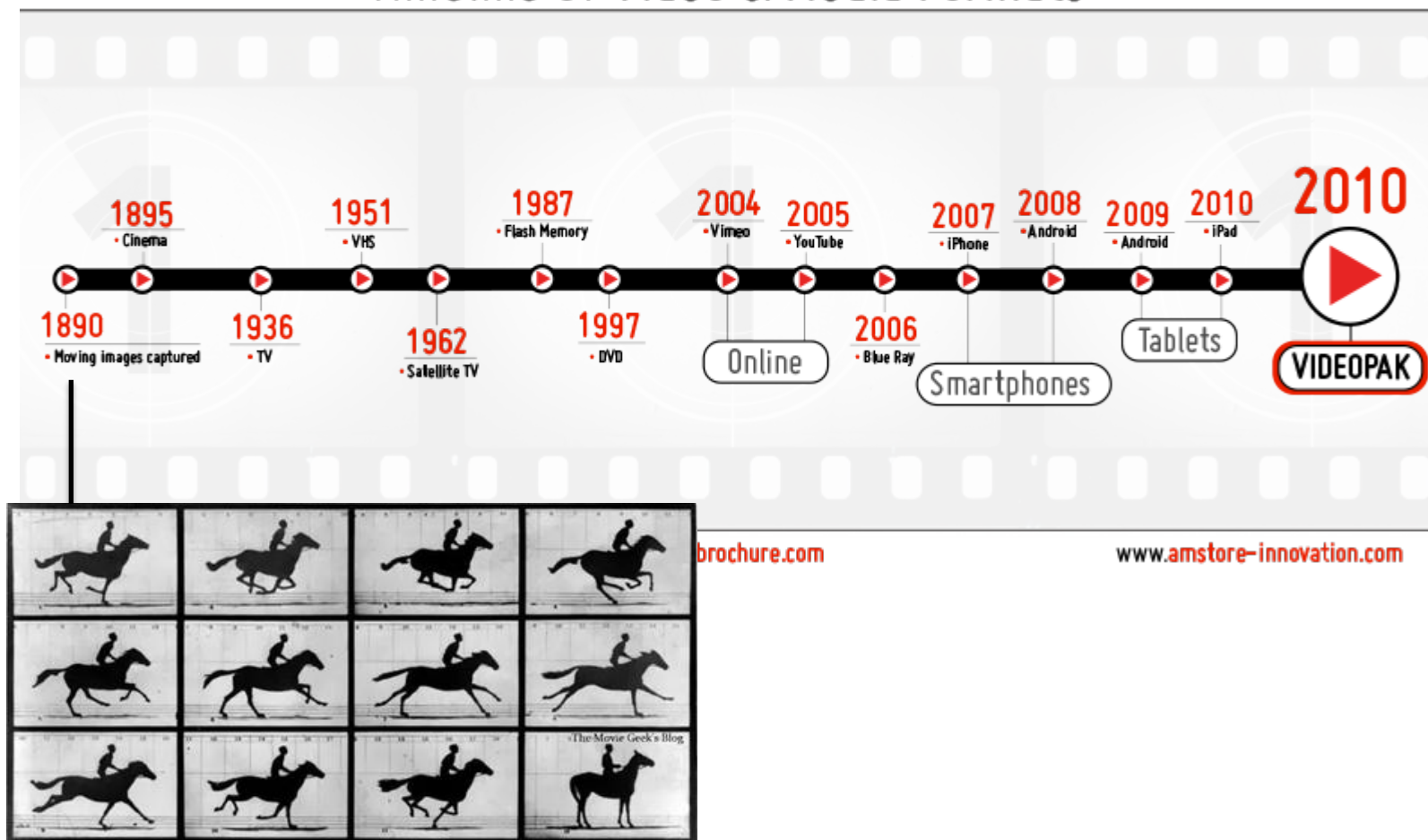
Hydrocephalic



- Jackler RK. 2000, p. 180: *Tumors of the Ear and Temporal Bone* •

Udvikling af akustikusneurinomkirurgien

Timeline of Video & Media Formats



Første operation 1894

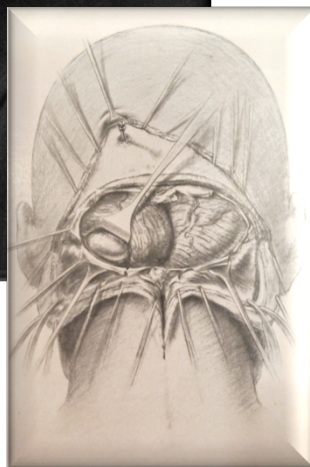


Sir Charles Ballance (1856 – 1936), UK

Tilskrives ofte den første operation for acusticusneurinom i 1894

Pt. levede 20 år efter operationen, men med bl.a. facialis- og trigeminusparalyse

Opererede via 'bilateral suboccipital adgang'



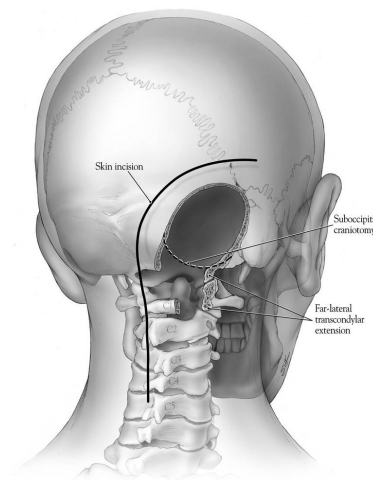
Adgang bag øret ('Retrosigmoid')



Fedor Krause (1857 - 1937), Tysk

Beskrev den 'unilaterale suboccipitale craniotomi' i 1903

Mortalitet omkr. 84%



Adgang gennem tindingebenet ('Translabyrintær')



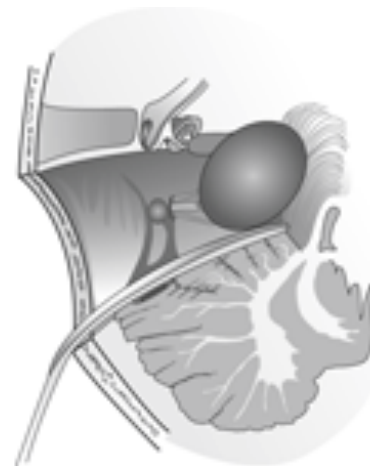
Prof. F. H. Quix,

de bekende neus-, keel- en oor-
specialist te Utrecht, zal aan de
Universiteit te Parijs een reeks
voordrachten houden.

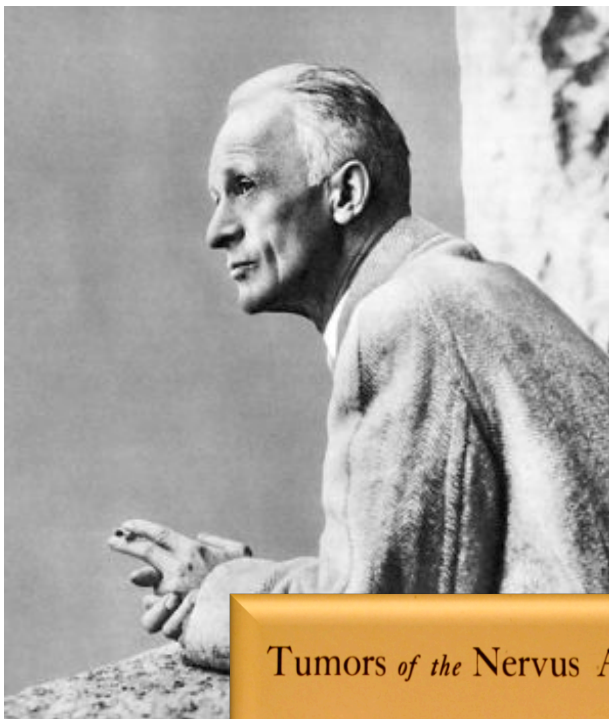
F. H. Quix (1874 – 1946), Hollænder

Første 'translabyrintære' operation i 1911
– fik kun fjernet lidt tumor

Dårlige resultater og stor kritik gjorde, at
teknikken blev forladt....



Neurokirurgiens udvikling i starten af det 20. årh.

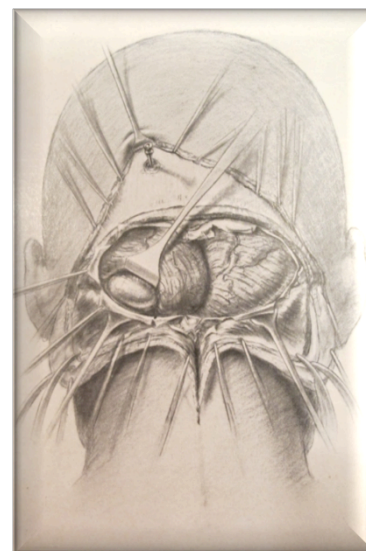
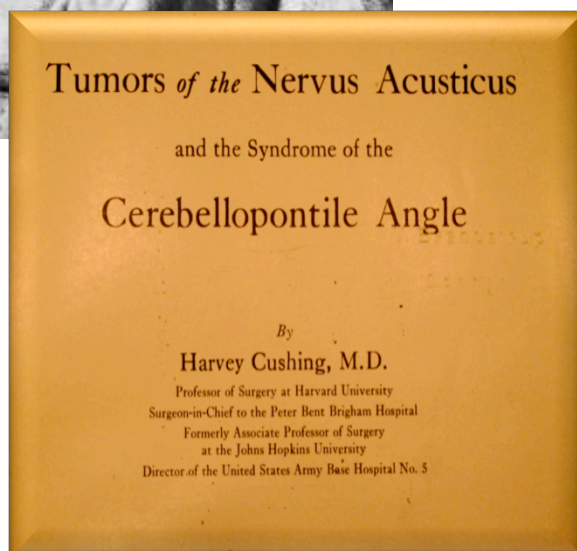


Harvey Cushing (1869 – 1939), USA

‘Neurokirurgiens fader’

Genindfører ‘bilateral suboccipital craniotomi’

1917: Mortalitet på 10-20%, men med mange recidiver pga. tumorrester



Og frem til 'moderne tid'

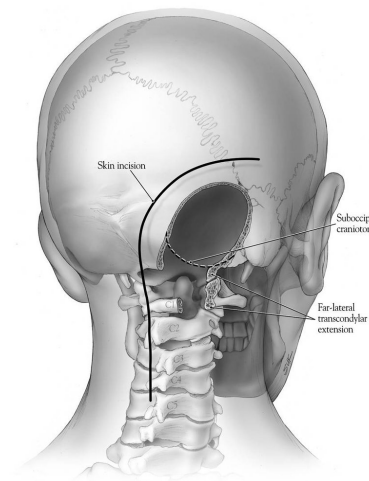
Walter Dandy (1886 – 1946), USA



1922: Reintroducerer unilat.
suboccipital adgang

Blev den dominerende teknik over de
næste 40 år

1945: 140 ptt, 22% mortalitet med 'total
tumorfjernelse'



Acustikusneurinomkirurgien i Danmark



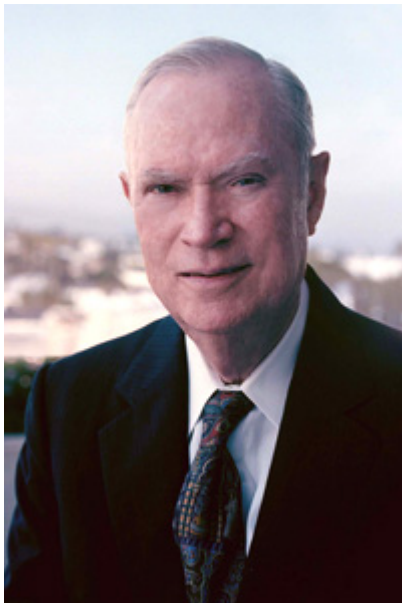
Eduard Busch (1899 – 1982), DK

Etablerer første NK afd. i DK i 1934

Opererede via unilateral suboccipital adgang ligesom efterfølgerne Riishede og Harmsen



Udvikling af moderne 'hjælpemidler'

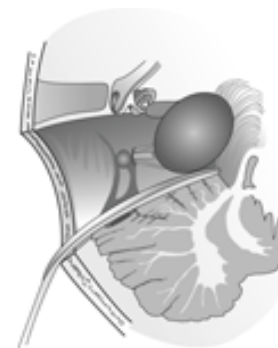


William House (1923 – 2012), USA

'Neuro-otologiens fader'

Re-introducerer den translabyrintære adgang til fjernelse af AN i 1961

1968: 200 ptt., 7% mortalitet, 95% bevaret facialisfunktion



Tidlige resultater i Danmark – vi ser, hvad der sker i USA

Jens Thomsen (1938 -)

Acta Otolaryngol 81: 406–414, 1976



SUBOCCIPITAL REMOVAL OF ACOUSTIC NEUROMAS

Results of 125 Operations

J. Thomsen

*From the University ENT and Neurosurgical Departments, Rigshospitalet,
Copenhagen, Denmark*

(Received August 15, 1975)

1957 – 1972 på RH

125 patienter

75% radikalitet

22% mortalitet – 13% efter mikroskop i 1969

18% 'poor outcome' (behøver hjælp i hjemmet)

84% Facialislammelse!

House, 1961 - 1968

200 patients

7% mortality

95% 'good facial function'

Indførelse af den translabyrintære kirurgi i Danmark



Mirko Tos (1931 – 2018)

Første translabyrintær fjernelse af AN på Gentofte i 1976

Sammen med Thornval, Thomsen, Riishede og Harmsen oprettes 'oto-neurokirurgisk gruppe'

Der oprettes register over alle patienter med AN i DK (I dag over 2500 ptt. registreret)

1981 100 translabyrintære operationer

1988 300 translabyrintære operationer.

1989 400 translabyrintære operationer

Charabi et al., UFL 1993:**1979 – 1990**

90% af AN opereret i oto-neurokirurgiske gruppe via TL adgang

10% opereret via SO adgang på 5 NK afdelinger (Omkring 1 operation/afdeling/år)

59 operationer

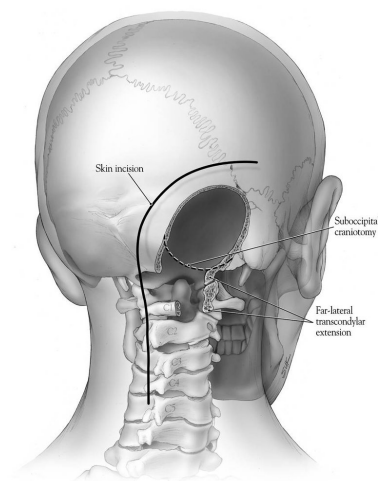
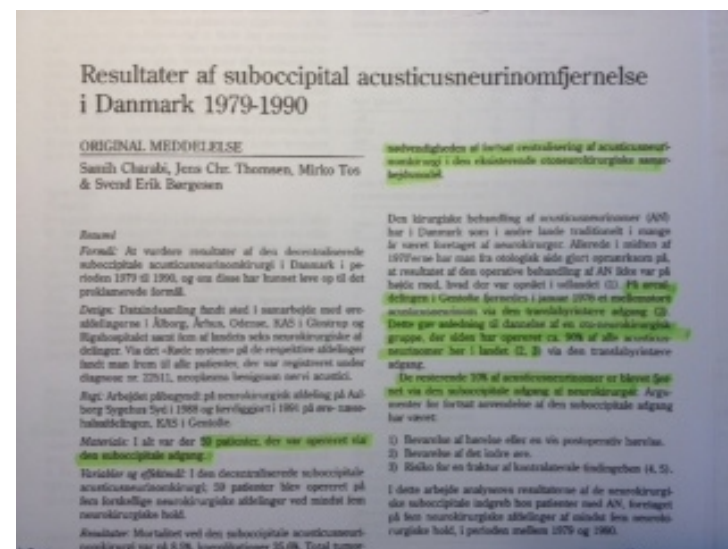
71,2% radikalitet

8,5% mortalitet

91,6% dårlig facialis funktion (HB 3-6)

35,6% komplikationer (8,5% hæmatomer)

På den baggrund centraliseres akustikusneurinom kirurgien i DK i 1992



Delkonklusioner

- Første operation for AN i 1894 og over de næste 20 år meget høj dødelighed på omkring 80%
- Fra 1920'erne og frem til 1960'erne var operation for AN stadig forbundet med en høj risiko for død, der gennem årene dog faldt til ca. 20%
- Fra 1960'erne og frem fald dødeligheden til under 10% og fokus blev nu flyttet mod bevarelse af facialisfunktionen.
- For at tilbyde den bedst mulige behandling blev behandling af AN i Danmark centraliseret i 1992.

Tiden fra 1976 til 2009...

Outcome after Translabyrinthine Surgery for Vestibular Schwannomas: Report on 1244 Patients

Jacob Bertram Springborg, M.D., Ph.D.¹ Kåre Fugleholm, M.D., Ph.D., D.MSc.¹ Lars Poulsen, M.D.¹
Per Cayé-Thomasen, M.D., D.MSc.² Jens Thomsen, M.D., D.MSc.² Sven-Eric Stangerup, M.D.²

¹University Clinic of Neurosurgery, Copenhagen University Hospital, Copenhagen Ø, Denmark

²Department of Oto-rhino-laryngology, Head and Neck Surgery, Gentofte University Hospital, Hellerup, Denmark

Address for correspondence and reprint requests Jacob Bertram Springborg, M.D., Ph.D., University Clinic of Neurosurgery, Copenhagen University Hospital, Blegdamsvej 9, 2100 Copenhagen Ø, Denmark (e-mail: jacob.springborg@rh.regionh.dk).

J Neurol Surg B 2012;00:1–8.

1976 til 2009:

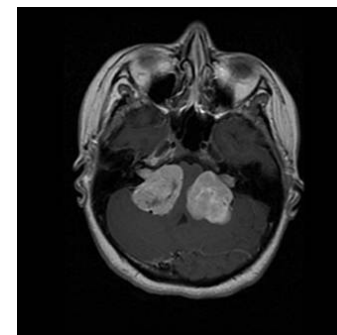
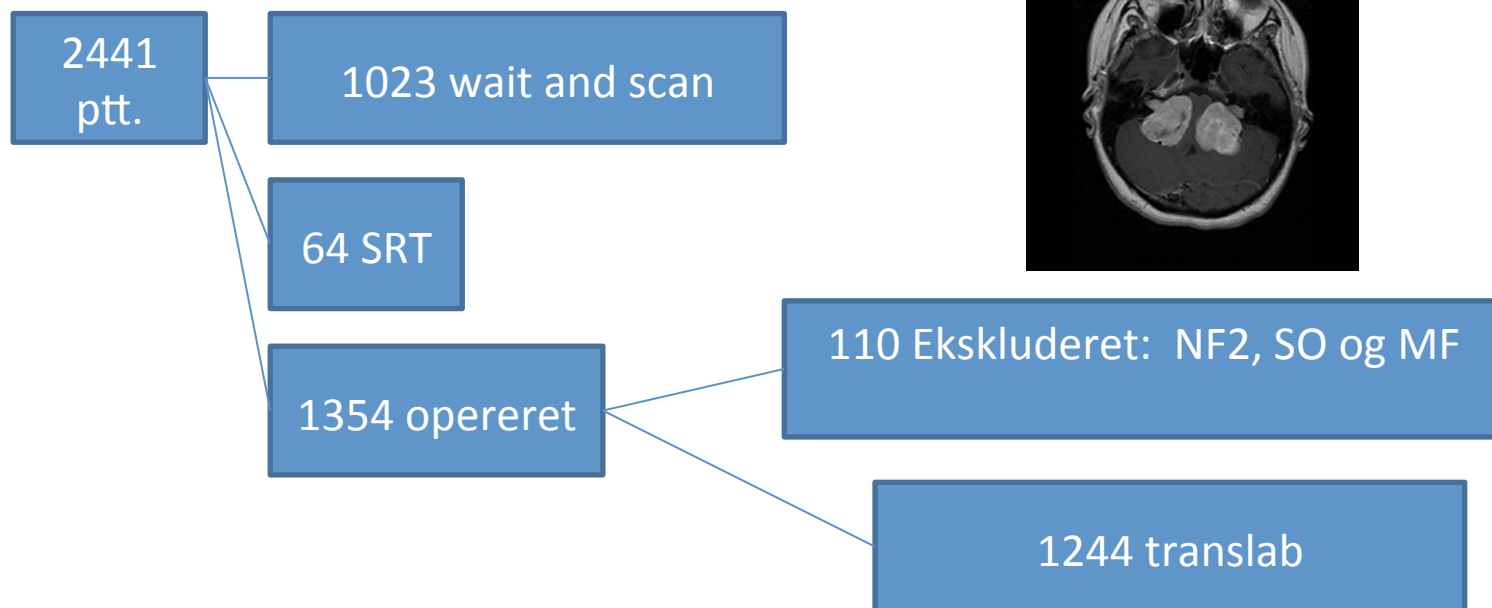


Table 1 Patient Characteristics, $N = 1244$

Mean Age (S.D.), Years	53 (13)
Sex, n (%)	
Women	691 (55.5)
Men	553 (44.5)
Side, n (%)	
Right	618 (49.5)
Left	628 (50.5)
Tumor location, n (%)	
Intrameatal	13 (1.0)
Intra- and extrameatal	1231 (99.0)
Mean tumor size (S.D.), mm ^a	25 (13)
Tumor size group, n (%) ^a	
0–10 mm	155 (12.6)
11–20 mm	373 (30.3)
21–30 mm	360 (29.2)
31–40 mm	172 (14.0)
>40 mm	171 (13.9)
Mean preoperative hearing level (S.D.)	
Pure tone average, dB	59 (25)
Discrimination loss, %	50 (36)
Preoperative HB grade, n (%)	
1	1170 (94.1)
2	6 (0.5)
3	63 (5.1)
4	0
5	1 (0.1)
6	4 (0.3)

^aTumors with extrameatal extension.
HB, House-Brackmann; S.D., ???.^{Q2}

Operationen:

Tumorfjernelse

84% total
13,7% næsten total (< 5% rest)
2,2 % subtotal (> 5% rest)

98%

Relateret til tumorstr. ($P < 0,0001$)

Facialis under operationen

85,2% intakt
8,4% tynd
6,5% ikke-intakt

Relateret til tumorstr. ($P < 0,0001$)

Facialisresultater efter 1 år:

70,3% god funktion (HB 1+2)

- 92,3% ved intrameatale tumorer
- 82% ved små tumorer (< 25mm)
- 55,6% ved større tumorer (> 25mm)

Relateret til tumor str. ($P < 0,0001$)

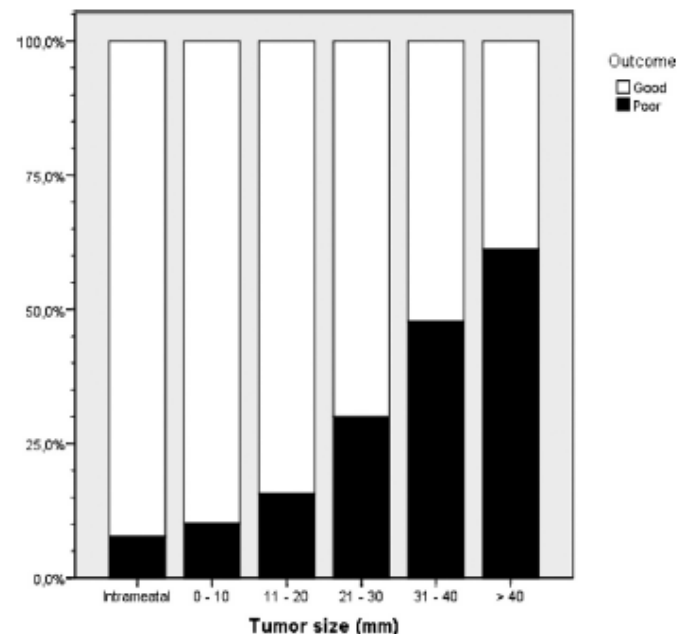


Table 2 Facial Nerve Function After 1 Year Based on Tumor Size

		Intrameatal	Intra- and Extrameatal					Total
			0-10 mm	11-20 mm	21-30 mm	31-40 mm	>40 mm	
House-Brackmann grade	1	12 (92.3%)	116 (77.9%)	246 (67.8%)	166 (49.4%)	54 (34.4%)	44 (32.8%)	638 (55.4%)
	2		17 (11.4%)	55 (15.2%)	66 (19.3%)	27 (17.2%)	8 (6.0%)	172 (14.9%)
	3	1 (7.7%)	7 (4.7%)	29 (8.0%)	35 (10.4%)	21 (13.4%)	17 (12.7%)	110 (9.5%)
	4		3 (2.0%)	11 (3.0%)	19 (5.7%)	25 (15.9%)	12 (9.0%)	70 (6.1%)
	5		4 (2.7%)	4 (1.1%)	10 (3.0%)	8 (5.1%)	16 (11.9%)	42 (3.6%)
	6		1 (0.7%)	12 (3.3%)	35 (10.4%)	20 (12.7%)	37 (27.6%)	105 (9.1%)
No data			1 (0.7)	6 (1.7%)	6 (1.8%)	2 (1.3%)		15 (1.3%)
Total		13 (100%)	149 (100%)	363 (100%)	336 (100%)	157 (100%)	134 (100%)	1152 (100%)

Patients with facial paresis before surgery and the patients that died within one year postoperatively are not in the table. Percentages are percentages within each column.



Facialis ved udskrivelsen sammenlignet med efter 1 år:

66,8% har en grad af parese ved udskrivelsen, men 77,5% af disse bedres over tid – i 42,3% af tilfældene fra en dårlig funktion til en god funktion.

VIGTIGT MED LANG FOLLOW-UP INDEN STILLINGTAGEN TIL EVT.
ANASTOMOSE

Table 3 Facial Nerve Function after 1 Year based on Facial Function at Hospital Discharge

		House-Brackmann Grade At Discharge from Hospital							Total
		1	2	3	4	5	6	No Data	
House-Brackmann grade 1 year after surgery	1	361 (97.6%)	95 (79.2%)	101 (63.9%)	28 (32.9%)	20 (19.8%)	20 (7.0%)	1 (5.6%)	626 (55.0%)
	2	3 (0.8%)	18 (15.0%)	37 (23.4%)	31 (36.5%)	33 (32.7%)	46 (16.0%)	4 (22.2%)	172 (15.1%)
	3	3 (0.8%)	6 (5.0%)	16 (10.1%)	14 (16.5%)	19 (18.8%)	49 (17.1%)	2 (11.1%)	119 (9.6%)
	4			3 (1.9%)	8 (9.4%)	16 (15.8%)	43 (15.0%)		70 (6.1%)
	5	1 (0.3%)	1 (0.8%)		1 (1.2%)	12 (11.9%)	27 (9.4%)		42 (3.7%)
	6	2 (0.5%)		1 (0.6%)	2 (2.4%)	1 (1.0%)	99 (34.5%)		105 (9.2%)
No data					1 (1.2%)		3 (1.0%)	11 (61.1%)	15 (1.3%)
Total		370 (100%)	120 (100%)	158 (100%)	85 (100%)	101 (100%)	287 (100%)	18 (100%)	1139 (100%)

Patients with intrameatal tumors or preoperative facial paresis and patients who died within 1 year postoperatively are not included in the table. Percentages are percentages within each column.

Komplikationer

Død < 1 mdr (1%)

12 ptt. (ca. 1%):

- 8 hæmatomer
- 2 lungeembolier
- 1 AMI
- 1 basilaristrombe

- Median tumorstr. 35 mm og 4 ptt. > 40 mm.
- Median alder 65 år og 5 ptt. over 70 år.

Sivning af hjernevæske (13,5%)

9% fra sår

- 39% konservativ behandling
- 21% lumbalt dræn
- 39% revision

4,5% rhinoliquorrhea

- 14% konservativ behandling
- 38% lumbalt dræn
- 48% revision



DELILAH'S NOSE

Delkonklusioner (1976 til 2009)

- Ca. 98% total eller næsten-total fjernelse
- Omkring 70% med god facialisfunktion, men afh. af tumorstr.
- Hvis initial facialisparese – god chance for bedring over 1 år
- Ikke ufarlig operation – særligt store tumorer og hos ældre
- En del sivningsproblemer

Ubesvaret spørgsmål

- Vækst af små rester?

Tumorrester?

The Journal of Laryngology & Otology (2013), 127, 568–573.

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doi:10.1017/S0022215113000844

Residual tumour after vestibular schwannoma surgery

C H HAHN¹, S E STANGERUP^{1,2}, P CAYE-THOMASEN^{1,2}

¹Department of Oto-rhino-laryngology, Head and Neck Surgery, University Hospital Rigshospitalet, Copenhagen, and ²Faculty of Health Sciences, University of Copenhagen, Denmark

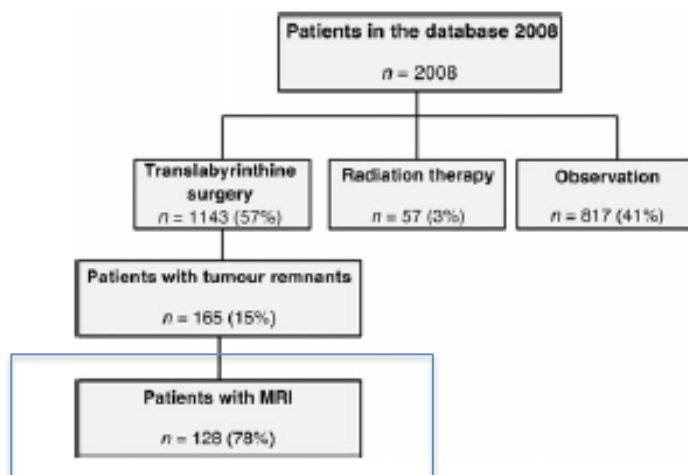


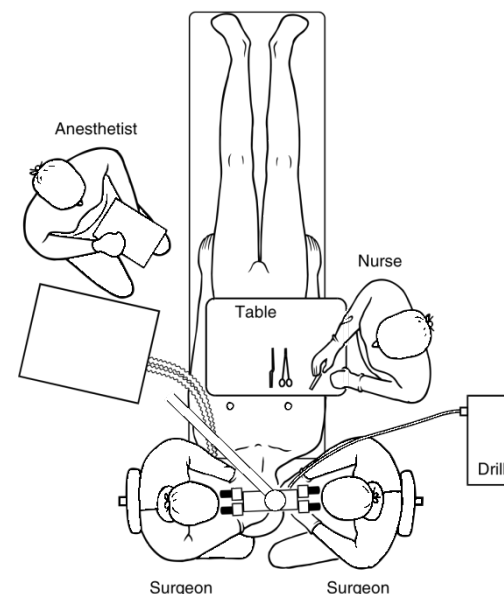
FIG. 1

Flow diagram showing the study population. MRI = magnetic resonance imaging

- At surgery, residual vestibular schwannoma may intentionally be left to preserve facial nerve function or prevent complications
- Most residual tumour remnants disappear spontaneously, probably due to devascularisation
- Few patients with a small tumour remnant will require revision surgery
- Tumour remnant size is the most important predictor of revision surgery

Fra 2009 og frem

- Dedikerede kirurger (skull base team)
- 'Four hand technique'
- Fire hænder arbejder samtidig
- To hjerner tænker samtidig
- Hurtigere operationstid



Increased Operative Time for Benign Cranial Nerve Tumor Resection Correlates with Increased Morbidity Postoperatively

Meghan Murphy¹ Hannah Gilder¹ Brandon A. McCutcheon¹ Panagiotis Kerezoudis¹
 Lorenzo Rinaldo¹ Daniel Shepherd¹ Patrick Maloney¹ Kendall Snyder¹ Matthew L. Carlson²
 Bob S. Carter³ Mohamad Bydon¹ Jamie J. Van Gompel¹ Michael J. Link¹

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Address for correspondence: Mohamad Bydon, MD, Department of Neurologic Surgery, Mayo Clinic, College of Medicine, Mayo Clinic, 200 First St SW, Rochester, MN, 55905, United States
 (e-mail: Bydon.Mohamad@mayo.edu).

J Neurol Surg B 2016;77:350–357.

We propose that in addition to a surrogate effect, operative duration may also be an independent risk factor.

Each additional minute of operative time was associated with an increased odds of overall complication (OR 1.004, 95% CI 1.002–1.006) and increased

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Journal of Neurosurgical Sciences 2016 March;69(1):54-69

REVIEW
TREATMENT OF INTRACRANIAL ANEURYSMS

Retractorless surgery for intracranial aneurysms

Hai SUN, Sam SAFAVI-ABBASI, Robert F. SPETZLER*

Department of Neurosurgery Barrow Neurological Institute St. Joseph's Hospital and Medical Center Phoenix, Arizona, USA

*Corresponding author: Robert F. Spetzler, c/o Neuroscience Publications, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, 350 W. Thomas Road, Phoenix, AZ 85013, USA. E-mail: Neuropub@dignityhealth.org

ing editorial in this issue, p 290.

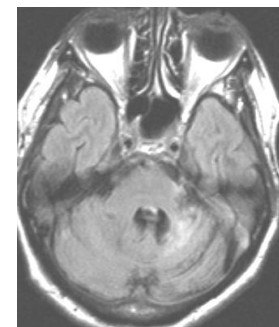
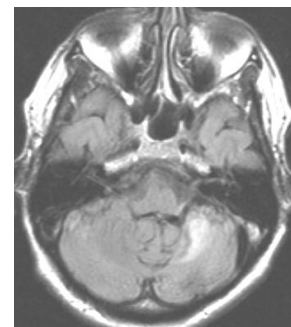
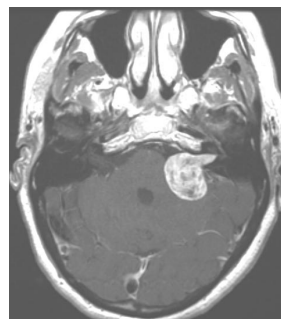
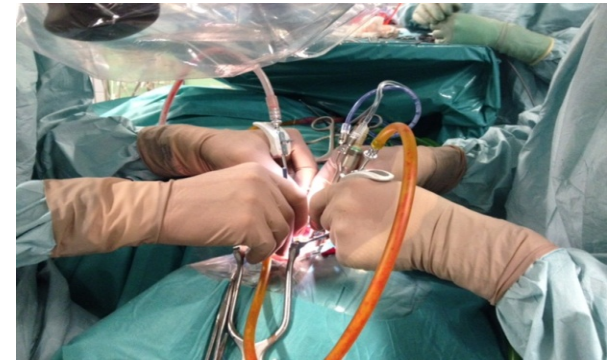
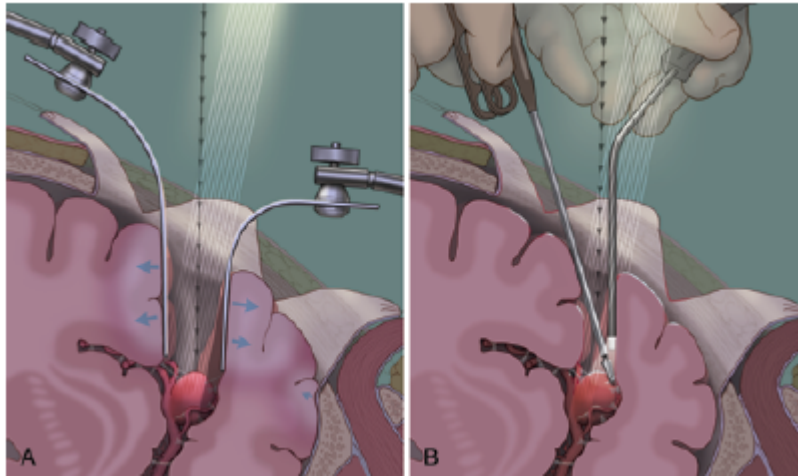
J Neurosurg 116:291-300, 2012

The quiet revolution: retractorless surgery for complex vascular and skull base lesions

Clinical article

ROBERT F. SPETZLER, M.D., AND NADER SANAI, M.D.

Division of Neurological Surgery, Barrow Neurological Institute, St. Joseph's Hospital and Medical Center, Phoenix, Arizona



Nyeste data fra Neurokirurgisk Klinik

Jan 2009 – Okt 2016 (Tidligere studie 1976 – 2009)

211 patienter

53% kvinder / 47% Mænd

Medianalder 54 år (IQR 19) (53 y)

Median tumorstr. 30 mm (IQR 11) (25 mm)

55% medium (≤ 30 mm) / 45% store (> 30 mm) (72% / 28%)

43% Retrosigmoid / 57% Translabryntær

11 patienter (5%) hørebevarende ('Bred indikation')

Under operationen

Tumorfjernelse

Total 49% (84%)

Små rester 39% (14%)

Større rester 12% (2%)

Forklaring

Større tumorer

Bevare facialsfunktion!

Operationstid

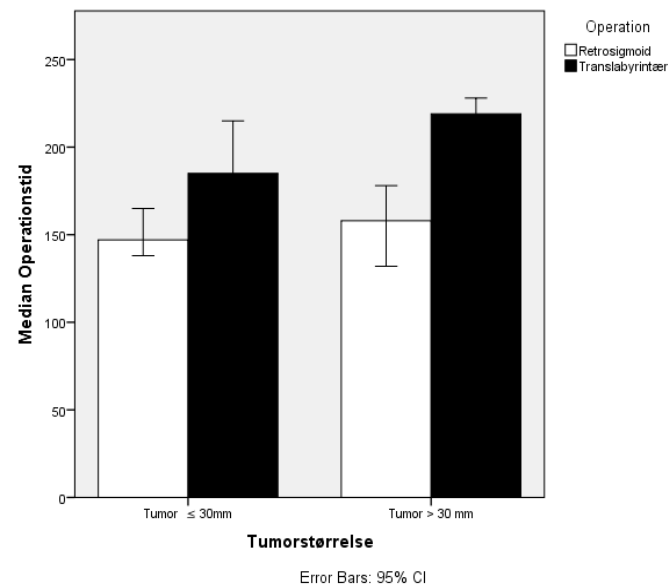
'Skin-to-skin'

Retrosig 149 min (IQR 61) $\approx$ 2,5 time

Translab 209 min (IQR 69) $\approx$ 3,5 time

Increased Operative Time for Benign Cranial Nerve Tumor Resection Correlates with Increased Morbidity Postoperatively

Meghan Murphy¹ Hannah Gilder¹ Brandon A. McCutcheon¹ Panagiotis Kerezoudis¹
 Lorenzo Rinaldo¹ Daniel Shepherd¹ Patrick Maloney¹ Kendall Snyder¹ Matthew L. Carlson²
 Bob S. Carter³ Mohamad Bydon¹ Jamie J. Van Gompel¹ Michael J. Link¹



370 min (6 timer), 565 procedurer

Facialsfunktion efter 1 år

Overordnet 83% (HB 1 + 2)

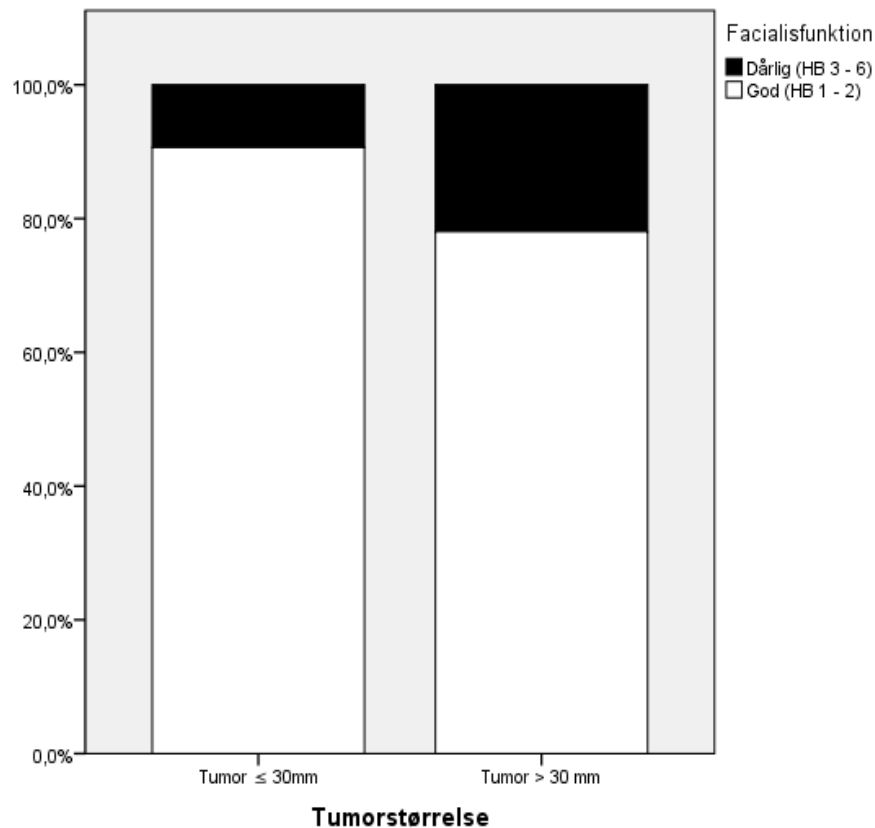
70% i tidligere studie



Hørelse

44% efter 3 måneder

22% med tumor > 30 mm

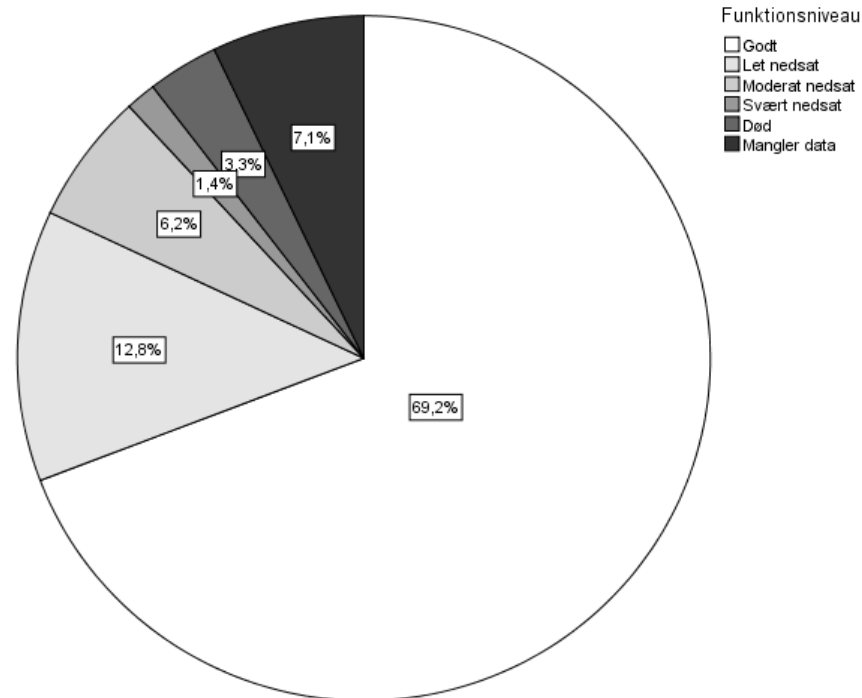


Overordnet funktionsniveau efter 1 år

Retrospektive data fra journaler!

Ikke spørgeskemaer

82% god eller let nedsat funktion



CLINICAL ARTICLE

J Neurosurg 122:833–842, 2015

Long-term quality of life in patients with vestibular schwannoma: an international multicenter cross-sectional study comparing microsurgery, stereotactic radiosurgery, observation, and nontumor controls

Matthew L. Carlson, MD,¹ Øystein Vesterli Tveiten, MD,³ Colin L. Driscoll, MD,^{1,2}
 Frederik K. Goplen, MD, PhD,⁴ Brian A. Neff, MD,¹ Bruce E. Pollock, MD,²
 Nicole M. Tombers, RN,¹ Marina L. Castner, RN,² Monica K. Finnirk, RN,³
 Erling Myrseth, MD, PhD,³ Paal-Henning Pedersen, MD, PhD,^{3,5}
 Morten Lund-Johansen, MD, PhD,^{3,5} and Michael J. Link, MD^{1,2}

22% reduceret efter kirurgi ift. 'normal controls', men 13% er forklaret af selve sygdommen

Komplikationer

4 døde < 1 måned

- Post-op hæmatom (dag 4) – aneurismeklips?
- Akut SDH (dag 30) – fald under rehabilitering
- Lungeproblemer (day 8) – 88 år gammel
- AMI (day 2) – kendt med svær nyresygdom

Medianalder 69 år (54 år i gennemsnit)

Sivning

4,7% Rhinoliqorrhea → Re-operation

8,5% fra sår → 95% konservativ behandling

Delkonklusioner 2009 og frem

- Vi prøver at undgå lange operationer og spateltryk
- Vi efterlader rester for at bevare facialisfunktionen
- Høj chance for god facialisfunktion efter 1 år (Gnsn. 83%)
- Hørelsen kan i sjældnere tilfælde reddes selv ved større tumorer
- Overordnet set god prognose
- Stadig risikabel kirurgi – særligt hos ældre
- Stadig problemer med sivning hos omkring 5%

I forhold til resten af verden?

Br J Neurosurg. 2010 Dec;24(6):666-71. doi: 10.3109/02688697.2010.520761.

Preservation of facial nerve function after resection of vestibular schwannoma.

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Abstract

OBJECTIVE: Most data regarding facial nerve function in patients undergoing microsurgical resection of vestibular schwannomas predominantly include series performed at a single institution. In an effort to minimise individual surgeon or institutional bias, we performed an analysis of the published literature on facial nerve outcomes following microsurgical resection of vestibular schwannomas. The objective of this study was to provide a comprehensive assessment of reported outcomes for facial nerve preservation after VS surgery.

MATERIALS AND METHODS: We identified a total of 296 studies involving over 25,000 patients that included outcome data for facial nerve function of vestibular schwannoma patients treated surgically. Data regarding surgical approach, tumour size, patient age, and use of intra-operative monitoring were extracted and correlated with facial nerve function after surgery. Patients with preoperative facial nerve dysfunction (House-Brackmann score 3 or higher) were excluded and 'facial nerve preservation' was defined as grade I or II House-Brackmann function at last follow-up visit.

RESULTS: A total of 79 articles reporting on 11,873 patients met our inclusion criteria contributing to our analysis. Patients treated with the middle cranial fossa approach had a trend towards higher overall facial nerve preservation rate (85%), compared to the translabyrinthine approach (81%, $p=0.07$), and did statistically better than the retrosigmoid approach (78%, $p<0.0001$). Patients with an average tumour size <20 mm had significantly improved facial nerve preservation rates, compared to larger tumours (90% vs. 67%, $p<0.0001$). Patients under 65 years of age had a lower facial nerve preservation rate (71% vs. 84%, $p<0.001$). Finally, the use of intra-operative monitoring improved the facial nerve preservation rate (76% vs. 71%, $p<0.001$).

CONCLUSION: Factors that appear to be associated with facial nerve preservation after microsurgical resection of a vestibular schwannoma include tumour size <20 mm, use of the middle fossa approach and use of neuromonitoring during surgery. These data provide a summary assessment of the published literature regarding facial nerve preservation after microsurgical resection of vestibular schwannoma.

PMID: 21070151 [PubMed - indexed for MEDLINE]

Ca. 80% har god facialis funktion (alle tumorstørrelser)

...ekspertcentre?

Neurosurgery. 2013 Jun;72(2 Suppl Operative):ons103-15; discussion ons115. doi: 10.1227/NEU.0b013e3182752b05.

Contemporary surgical management of vestibular schwannomas: analysis of complications and lessons learned over the past decade.

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Abstract

BACKGROUND: Despite advanced microsurgical techniques, more refined instrumentation, and expert team management, there is still a significant incidence of complications in vestibular schwannoma surgery.

OBJECTIVE: To analyze complications from the microsurgical treatment of vestibular schwannoma by an expert surgical team and to propose strategies for minimizing such complications.

METHODS: Surgical outcomes and complications were evaluated in a consecutive series of 410 unilateral vestibular schwannomas treated from 2000 to 2009. Clinical status and complications were assessed postoperatively (within 7 days) and at the time of follow-up (range, 1-116 months; mean, 32.7 months).

RESULTS: Follow-up data were available for 357 of the 410 patients (87.1%). Microsurgical tumor resection was performed through a retrosigmoid approach in 70.7% of cases. Thirty-three patients (8%) had intrameatal tumors and 204 (49.8%) had tumors that were <20 mm. Gross total resection was performed in 306 patients (74.6%). Hearing preservation surgery was attempted in 170 patients with tumors <20 mm, and good hearing was preserved in 74.1%. The main neurological complication was facial palsy (House-Brackmann grade III-VI), observed in 14% of patients (56 cases) postoperatively; however, 59% of them improved during the follow-up period. Other neurological complications were disequilibrium in 6.3%, facial numbness in 2.2%, and lower cranial nerve deficit in 0.5%. Nonneurological complications included cerebrospinal fluid leaks in 7.6%, wound infection in 2.2%, and meningitis in 1.7%.

CONCLUSION: Many of these complications are avoidable through further refinement of operative technique, and strategies for avoiding complications are proposed.

PMID: 23037828 [PubMed - in process]

Blandet translabyrinthær (29%) og retrosigmoid (71%)

Ca. 50% små tumorer (< 20 mm)

Ca. 86% god facialisfunktion

Sivning hos 7.6%



Strålebehandling ved små og mellemstore tumorer (< 25mm)?



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PATIENT OUTCOMES AFTER VESTIBULAR SCHWANNOMA MANAGEMENT: A PROSPECTIVE COMPARISON OF MICROSURGICAL RESECTION AND STEREOTACTIC RADIOSURGERY

OBJECTIVE: The best management for patients with small- to medium-sized vestibular schwannomas (versus) is controversial.

METHODS: Prospective cohort study of 82 patients with unilateral, unoperated versus less than 3 cm having surgical resection ($n = 36$) or radiosurgery ($n = 46$). Patients having resection were younger (48.2 yr versus 53.9 yr, $P = 0.03$). The groups were similar with regard to hearing loss, associated symptoms, and tumor size. The mean follow-up was 42 months (range, 12 to 62).

RESULTS: Normal facial movement and preservation of serviceable hearing was more frequent in the radiosurgical group at three months ($P < 0.001$), 1-year ($P < 0.001$), and at last follow-up ($P < 0.01$) compared to the surgical resection group. Patients having surgical resection had a significant decline in the following subscales of the Health Status Questionnaire (HSQ) three months after surgery: physical functioning ($P = 0.006$), role-physical ($P < 0.001$), energy/fatigue ($P = 0.02$), and overall physical component ($P = 0.004$). Patients in the surgical resection group continued to have a significant decline in the physical functioning ($P = 0.04$) and bodily pain ($P = 0.04$) subscales at one-year, and in bodily pain ($P = 0.02$) at last follow-up. The radiosurgical group had no decline on any component of the HSQ after the procedure. The radiosurgical group had lower mean Dizziness Handicap Inventory scores (16.5 versus 8.4, $P = 0.02$) at last follow-up. There was no difference in tumor control (100% versus 96%, $P = 0.50$).

CONCLUSION: Early outcomes were better for versus patients having stereotactic radiosurgery compared to surgical resection (Level 2 evidence). Unless long-term follow-up shows frequent tumor progression at currently used radiation doses, radiosurgery should be considered the best management strategy for the majority of versus patients.

KEY WORDS: acoustic neuroma, outcome, radiosurgery, vestibular schwannoma

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VESTIBULAR SCHWANNOMA: SURGERY OR GAMMA KNIFE RADIOSURGERY? A PROSPECTIVE, NONRANDOMIZED STUDY

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OBJECTIVE: To conduct a prospective, open, nonrandomized study of treatment-associated morbidity in patients undergoing microsurgery or gamma knife radiosurgery (GKRS) for vestibular schwannomas.

METHODS: Ninety-one patients with vestibular schwannomas with a maximum tumor diameter of 25 mm in the cerebellopontine angle were treated according to a prospective protocol either by GKRS (63 patients) or open microsurgery (28 patients) using the suboccipital approach. Primary end points included hearing function, according to the Gardner-Robertson scale, and facial nerve function, according to the House-Brackmann scale at 2 years. Clinical data included a balance platform test, score for tinnitus and vertigo using a visual analog scale, and working ability. Patients responded to the quality-of-life questionnaires Short-Form 36 and Glasgow Benefit Inventory.

RESULTS: Three elderly GKRS patients withdrew; all remaining patients were followed for 2 years. Both primary end points were highly significant in favor of GKRS ($P < 0.001$). Evidence of reduced facial nerve function (House-Brackmann grade 2 or poorer) at 2 years was found in 13 of 28 open microsurgery patients and 1 of 60 GKRS patients. Thirteen of 28 patients who underwent surgery had serviceable hearing (Gardner-Robertson grade A or B) preoperatively, but none had serviceable hearing postoperatively. Twenty-five of 60 GKRS patients had serviceable hearing before treatment, and 17 (68%) of them had serviceable hearing 2 years after treatment. The tinnitus and vertigo visual analog scale score, as well as balance platform tests, did not change significantly after treatment, and working status did not differ between the groups at 2 years. Quality of life was significantly better in the GKRS group at 2 years, based on the Glasgow Benefit Inventory questionnaire. One GKRS patient required operative treatment within the 2-year study period.

CONCLUSION: This is the second prospective study to demonstrate better facial nerve and hearing outcomes from GKRS than from open surgery for small- and medium-sized vestibular schwannomas.

KEY WORDS: facial nerve function, Gamma knife radiosurgery, Hearing preservation, Microsurgery, Quality of life, Vestibular schwannoma

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Livskvalitet?



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SF-36 QUESTIONNAIRE

Name: _____ Ref. Dr: _____ Date: _____
ID#: _____ Age: _____ Gender: M / F

Please answer the 36 questions of the **Health Survey** completely, honestly, and without interruptions.

GENERAL HEALTH:

In general, would you say your health is:

☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor

Compared to one year ago, how would you rate your health in general now?

☐ Much better now than one year ago
☐ Somewhat better now than one year ago
☐ About the same
☐ Somewhat worse now than one year ago
☐ Much worse than one year ago

LIMITATIONS OF ACTIVITIES:

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

☐ Yes, Limited a lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

☐ Yes, Limited a Lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Lifting or carrying groceries

☐ Yes, Limited a Lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Climbing several flights of stairs

☐ Yes, Limited a Lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Climbing one flight of stairs

☐ Yes, Limited a Lot ☐ Yes, Limited a Little ☐ No, Not Limited at all

Validation of a Disease-Specific Quality-of-Life Instrument for Acoustic Neuroma: The Penn Acoustic Neuroma Quality-of-Life Scale

Brian T. Shaffer, MD; Michael S. Cohen, MD; Douglas C. Bigelow, MD; Michael J. Ruckenstein, MD

Long-term quality of life in patients with vestibular schwannoma: an international multicenter cross-sectional study comparing microsurgery, stereotactic radiosurgery, observation, and nontumor controls

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Conclusions

Overall, the HRQOL differences following observation, microsurgery, and SRS are small. The diagnosis of VS, rather than treatment strategy, most significantly impacts patient quality of life.

Medicinsk behandling?



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Development of a Vestibular Schwannoma Xenograft Zebrafish Model for In Vivo Antitumor Drug Screening

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Da-Woon Jung, PhD; In Seok Moon, MD, PhD

Objectives/Hypothesis: The development of a simple, reliable, and cost-effective animal model greatly facilitates disease treatment. We aimed to establish a rapid, simple, and reproducible live zebrafish vestibular schwannoma xenograft model for antitumor drug screening.

Methods: We optimized each of the following conditions for tumor cell xenografts in zebrafish larvae: larval stage, incubation temperature, and injected cell number. We used NF2-/-mouse Schwann (SC4) cells and generated mCherry fluorescent protein-expressing cells prior to injection into zebrafish larvae. SC4 cells were counted using a fluorescence microscope, suspended in 10% fetal bovine serum, and injected into the center of the yolk sac using a microinjection system. The injected embryos were transferred to E3 medium (for zebrafish embryos), and subsequent tumor formation was observed by fluorescence microscopy over a 5-day period. To validate our model, xenografted embryos were transferred into 6-well plates (5 embryos per well) and treated with everolimus, a known antitumor drug.

Results: mCherry fluorescent protein-expressing SC4 cells were successfully grafted into the yolk sacs of zebrafish embryos without any immunosuppressant treatment. At 2 days postinjection, the xenografted cells had grown into tumor masses. The optimal speed of tumor formation depended on the larval stage (30 hpf), incubation temperature (31°C), and injected cell number (200 cells). In preliminary tests, everolimus treatment yielded a > 20% reduction in the number of SC4 cells in the yolk.

Conclusion: Our in vivo model has the potential to greatly facilitate vestibular schwannoma treatment because of its speed, simplicity, reproducibility, and amenability to live imaging.

Key Words: Vestibular schwannoma, zebrafish, xenograft, animal model.

Level of Evidence: NA

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'Personalized medicine'

