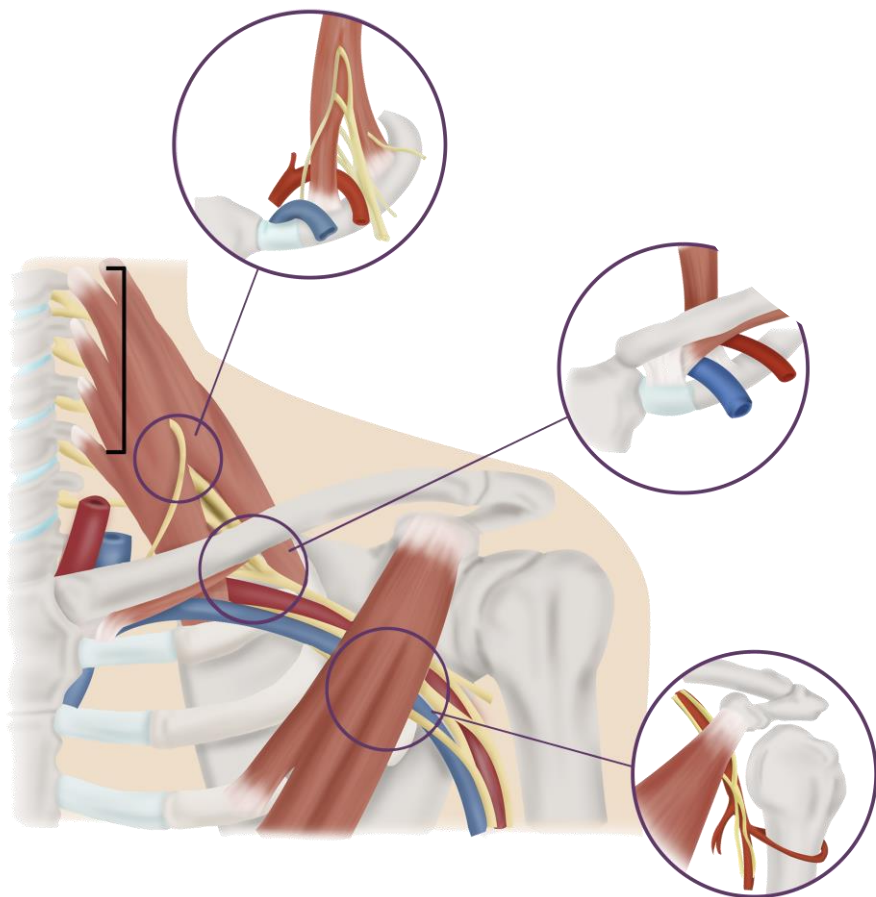




catharina
een santeon ziekenhuis

Het arteriële en veneuze Thoracic Outlet Syndroom: chirurgische behandeling

Jens Goeteyn



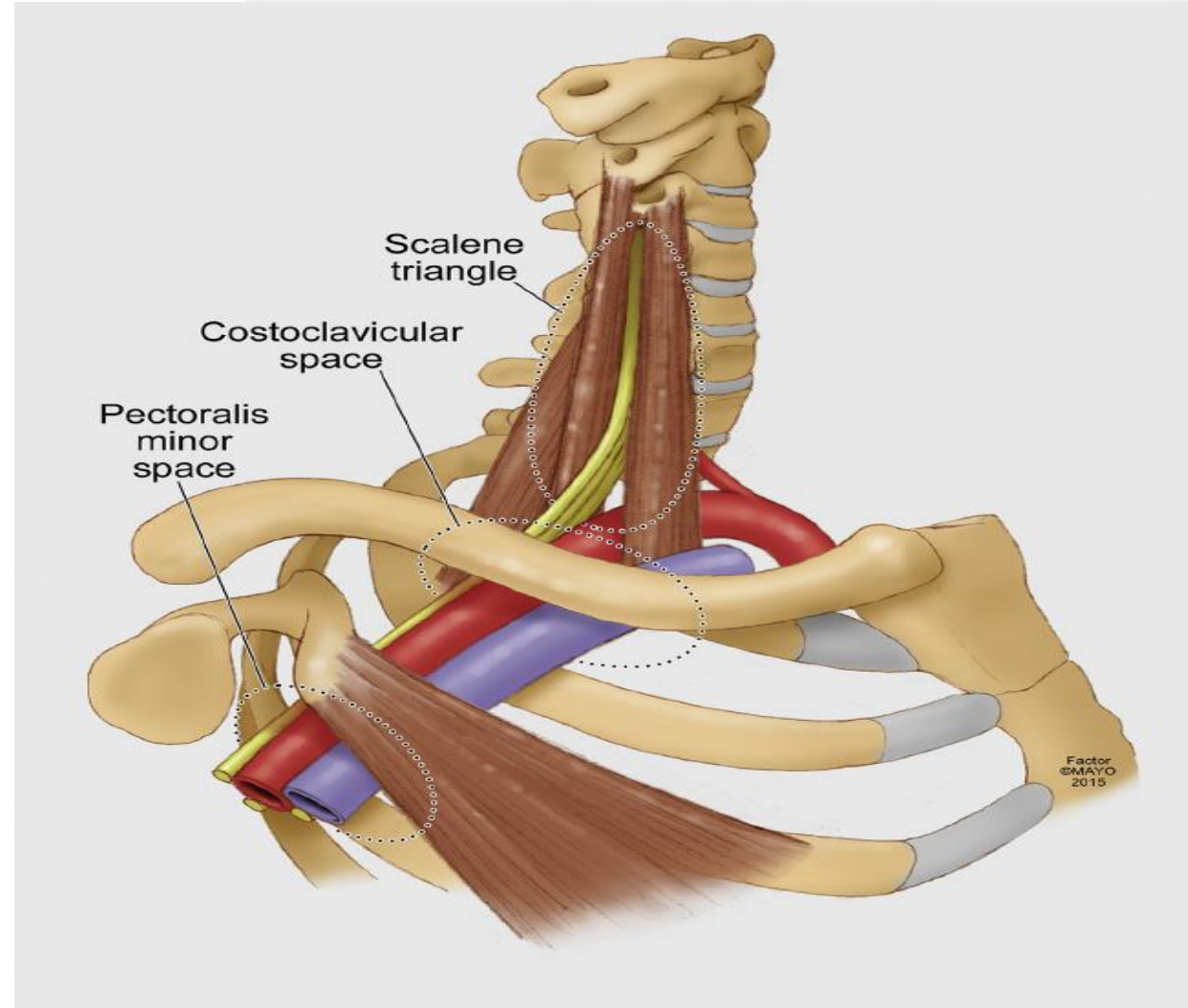
Algemeen



TOS = symptomatische beknelling van de neurovasculaire bundel thv de thoracic outlet

Thoracic outlet:

- Scalenius driehoek
- Costo-claviculaire ruimte
- Pectoralis minor ruimte

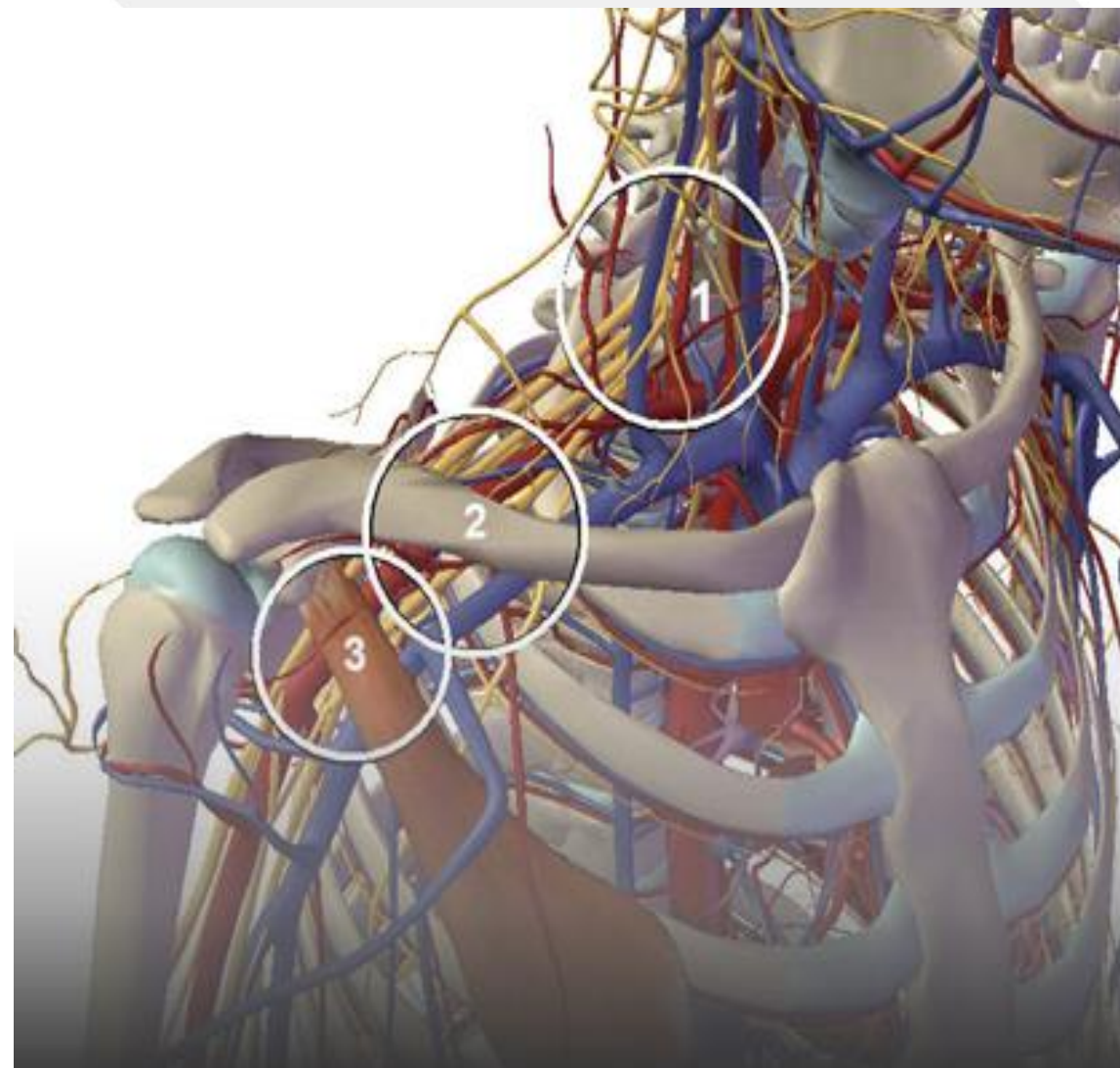


Algemeen



- **welke structuur?**

- NTOS (95%)
- VTOS (4%)
- ATOS (1%)
- Mixed TOS (%?)



Arteriële TOS

- Definitie:
 - Symptomatische ischemie (of)
 - Objectieve schade A. Subclavia
 - (stenose, aneurysma, occlusie)
 - In combinatie met anatomische varianten
 - Cervicale rib
 - Brede processus transversus C7
 - Ligamentaire banden
 - Uitzonderlijke situaties (clavicula #, insertie op tweede rib, ...)

Abnormality	Frequency (%)
Cervical rib	66
Anomalous first rib	16
Clavicular or first rib fracture	8
Fibrocartilagenous band	5
Elongated C7 transverse process	1

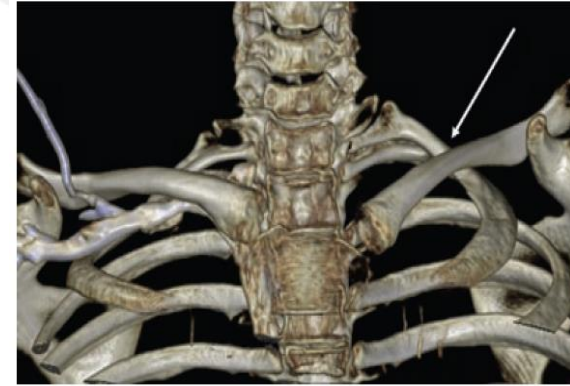


Fig. 84.2 CT reconstruction showing a left anomalous first rib inserting into the second rib (arrow)

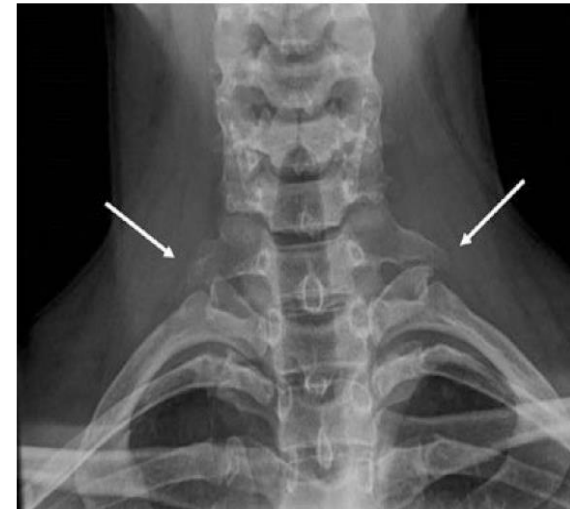
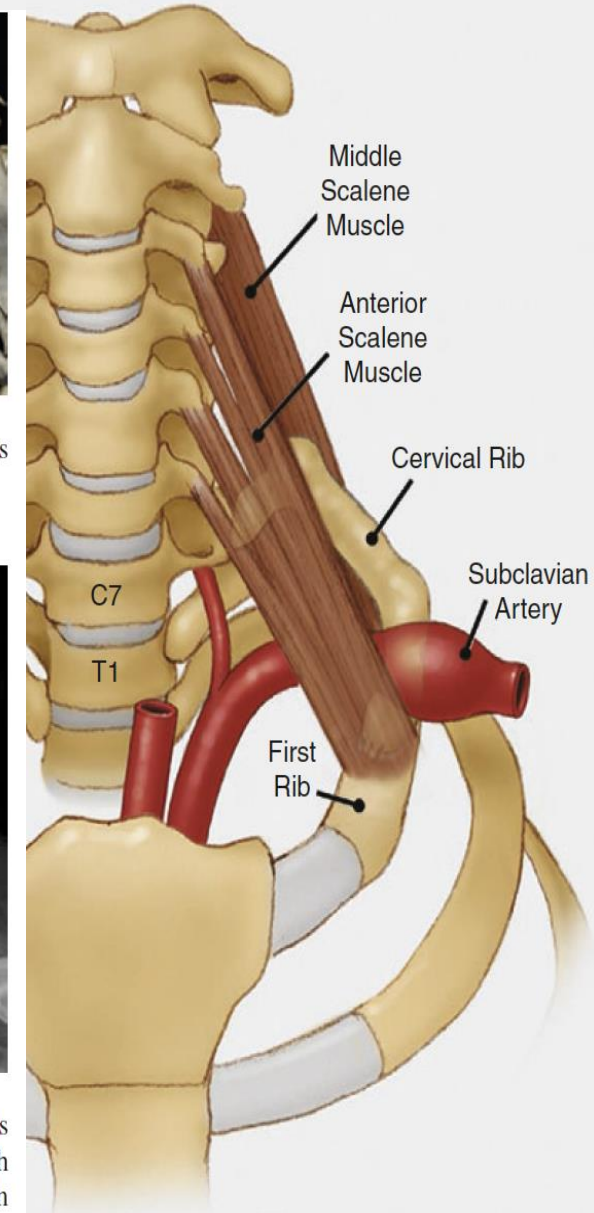


Fig. 84.3 Cervical spine X-ray of bilateral anomalous transverse processes (arrows). Both are elongated with right side measuring 1.3 cm and left side measuring 2 cm in length



Arteriële TOS

Definitie:

- Symptomatische isch
- Objectieve sch
- (stenos

Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome

Karl A. Illig, MD,^a Dean Donahue, MD,^b Andra Duncan, MD,^c Julie Freischlag, MD,^d Hugh Gelabert, MD,^e Kaj Johansen, MD,^f Sheldon Jordan, MD,^g Richard Sanders, MD,^b and Robert Thompson, MD,ⁱ Tampa, Fla; Boston, Mass; London, Ontario, Canada; Sacramento and Los Angeles, Calif; Seattle, Wash; Aurora, Colo; and St. Louis, Mo

one varianten

versus C7

anden

like situaties (clavicula #, insertie op

ue rib, ...)

Abnormality	Frequency (%)
Cervical rib	66
Anomalous first rib	16
Clavicular or first rib fracture	8
Fibrocartilagenous band	5
Elongated C7 transverse process	1

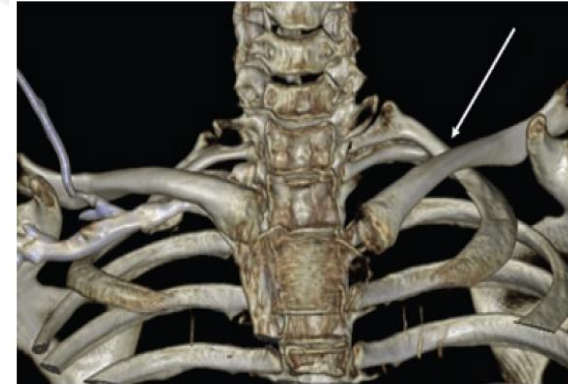


Fig. 84.2 CT reconstruction showing a left anomalous first rib inserting into the second rib (arrow)

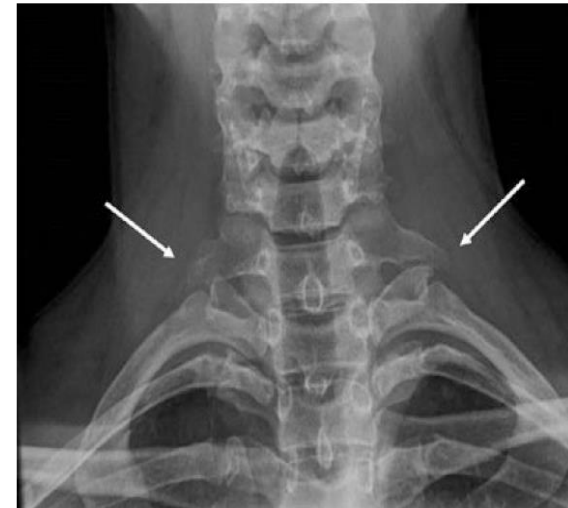
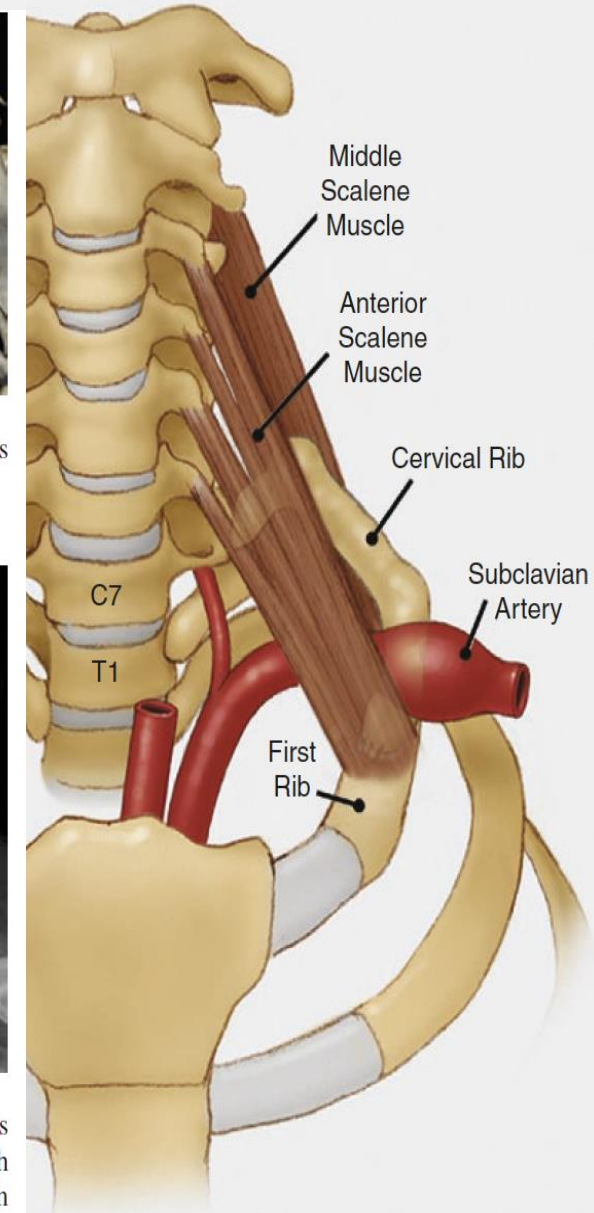
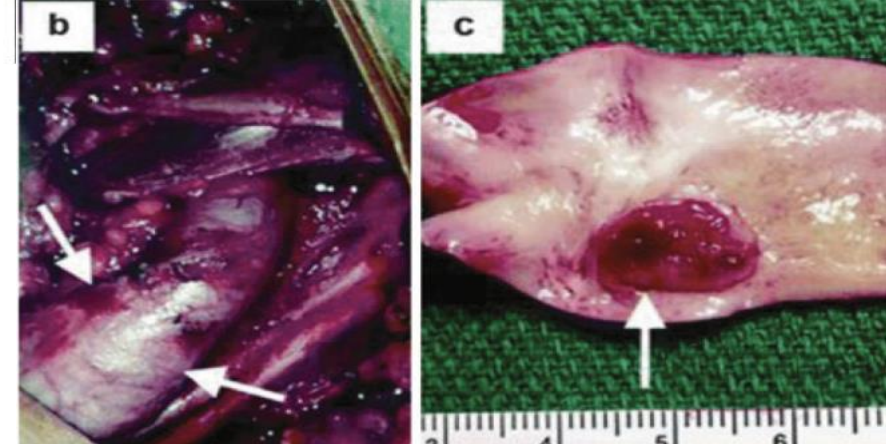
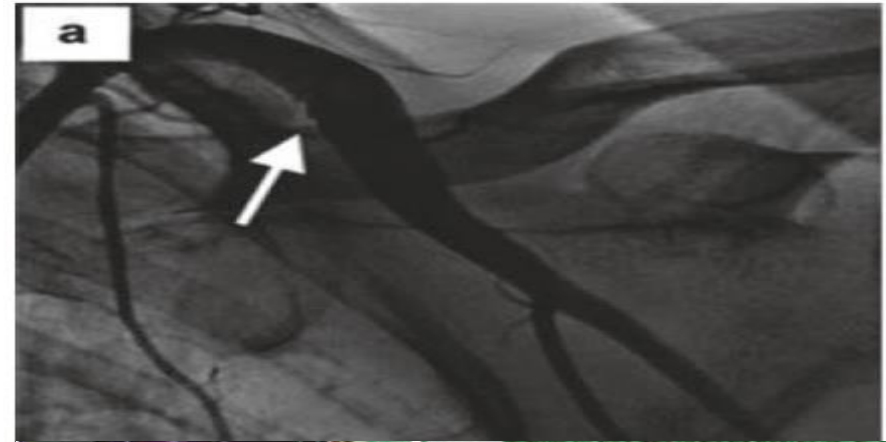
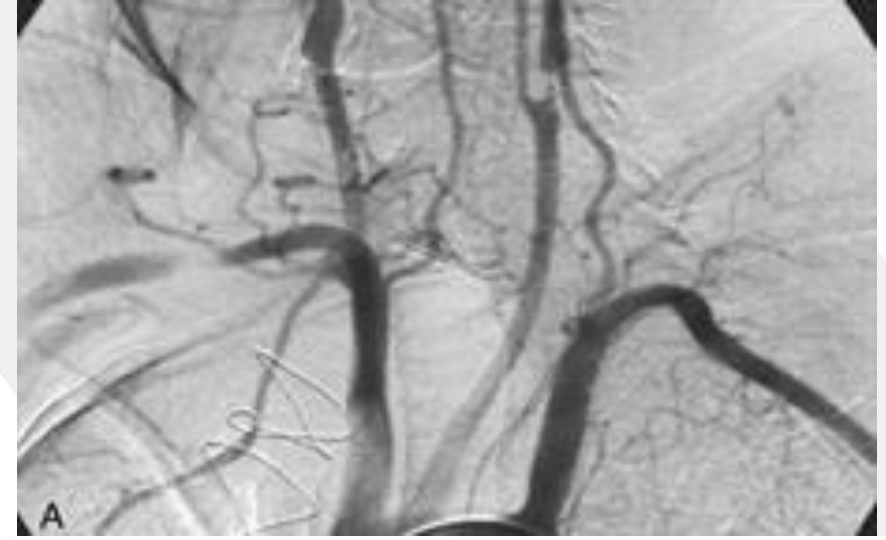


Fig. 84.3 Cervical spine X-ray of bilateral anomalous transverse processes (arrows). Both are elongated with right side measuring 1.3 cm and left side measuring 2 cm in length

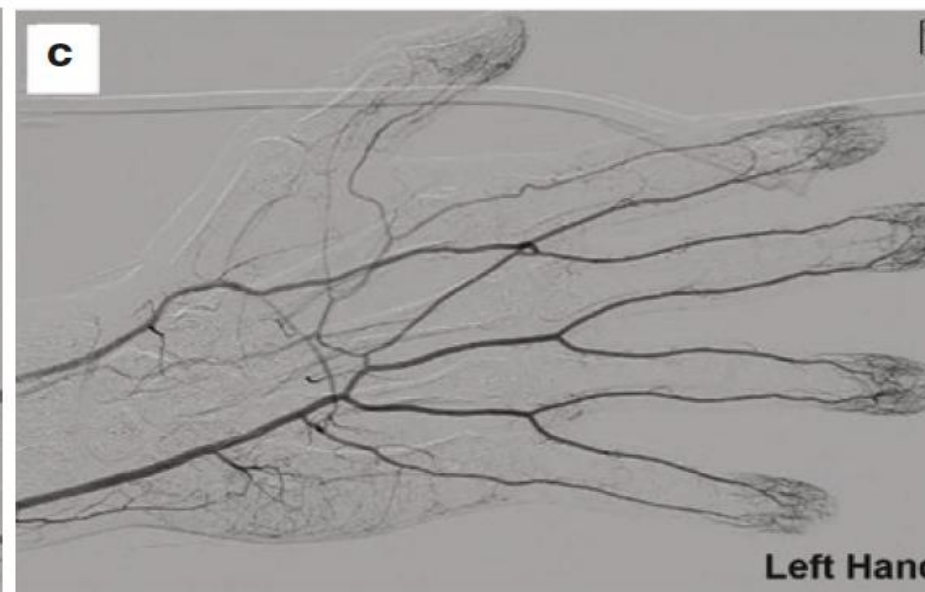
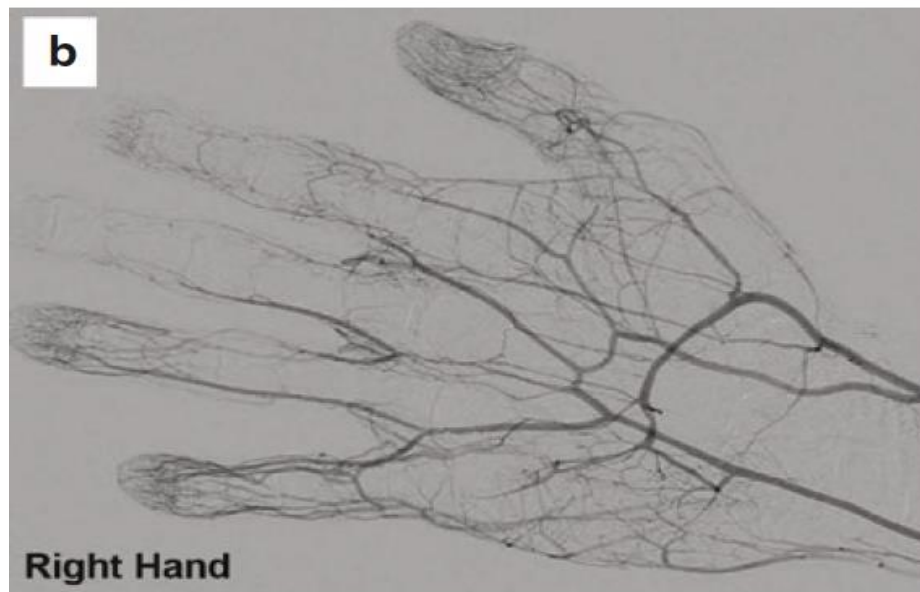
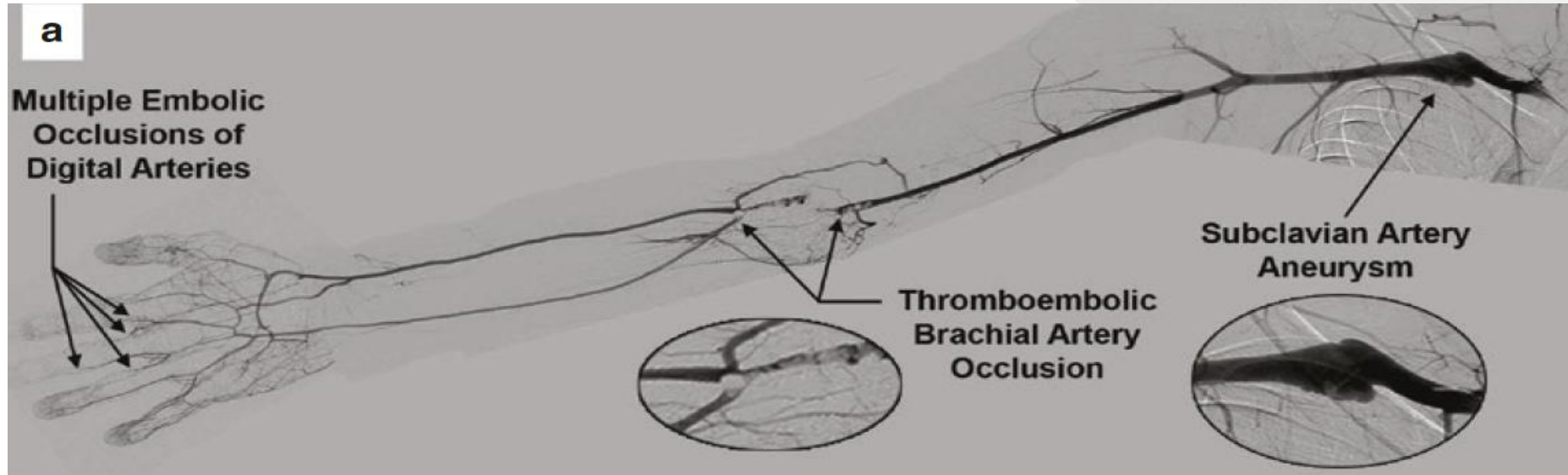


Arteriële TOS

- Objectieve schade (aneurysma, occlusie)
- Symptomen
 - Ischemie tgv occlusie
 - » Arm 'claudicatio'
 - Embolen
 - » Vingers
 - » Koude arm

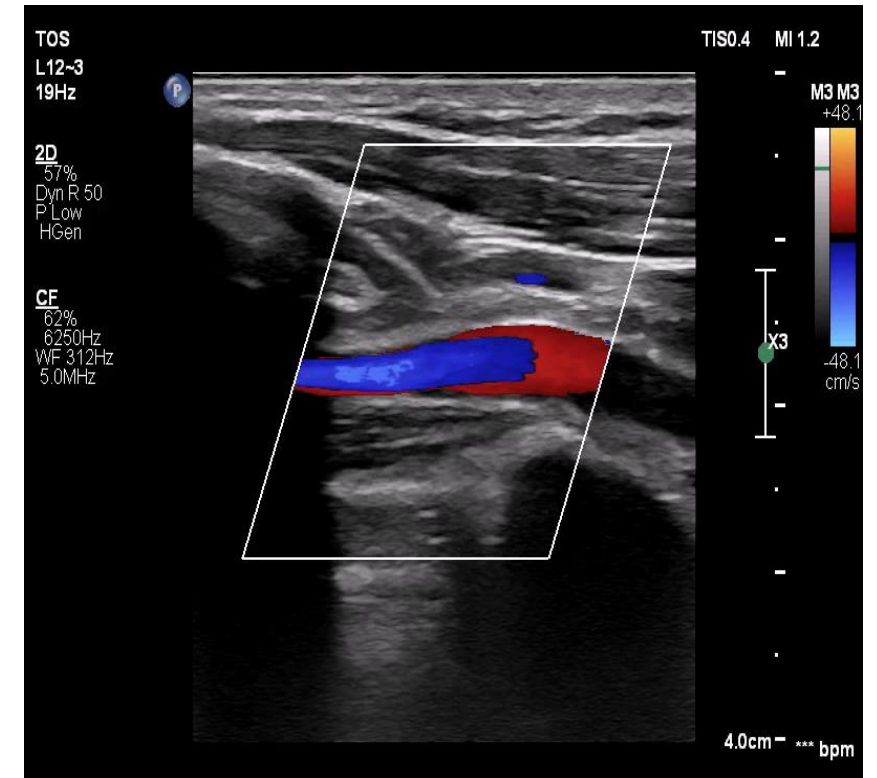


Arteriële TOS



Verwarring rondom ATOS

- Duplex wordt heel veel gebruikt in de work-up voor TOS
 - Afknelling van de A. Subclavia bij arm elevatie
 - Indien afknelling van de arterie, ook van de nabijgelegen plexus?



Verwarring rondom ATOS

- **Duplex** wordt heel veel gebruikt in de work-up voor TOS
 - Afknelling van de A. Subclavia bij arm elevatie
 - Indien afknelling van de arterie, ook van de nabijgelegen plexus?
 - Veel patiënten onder verdenking van TOS hebben
 - Verandering van kleur in de vingers
 - Koude vingers/handen
 - Wordt uitgelokt of erger gemaakt door arm elevatie
- Veel artsen wijten dit aan een afknelling van de A. Subclavia (= ATOS?)



Verwarring rondom ATOS



MAAR!

**1. STENOSE VAN DE A. SUBCLAVIA TIJDENS ELEVATIE VAN DE ARM
IS GEEN TOS**

**2. STENOSE VAN DE A. SUBCLAVIA OP DUPLEX HEEFT GEEN
WAARDE**

Verwarring rondom ATOS

- Gezonde personen
 - Duplex: 12 % heeft compressie A. Subclavia (>50 %)

- A. Subclavia stenose vrijwilligers en TOS patiënten'

Table 2. Mean Arterial Stenosis in the Interscalene Triangle, Costoclavicular Space, and Retropectoralis Minor Space in Volunteers (n = 45) and Patients (n = 28)

Abduction	Mean Arterial Stenosis ± SD, %								
	Interscalene Triangle			Costoclavicular Space			Retropectoralis Minor Space		
	Volunteers	Patients	P	Volunteers	Patients	P	Volunteers	Patients	P
90°	6 ± 14	6 ± 5	.55	18 ± 13	53 ± 30	<.01	2 ± 13	4 ± 9	.18
130°	8 ± 12	8 ± 6	.99	20 ± 16	78 ± 24	<.01	5 ± 13	7 ± 12	.43
170°	9 ± 11	10 ± 6	.82	32 ± 29	83 ± 23	<.01	5 ± 13	5 ± 11	.93

- PO2 metingen:
 - N = 130, gezonde proefpersonen
 - Unilateral compressie: 60%
 - Bilateral compressie: 33%

Article

A Prospective Evaluation of Duplex Ultrasound for Thoracic Outlet Syndrome in High-Performance Musicians Playing Bowed String Instruments

Garret Adam ¹, Kevin Wang ², Christopher J. Demaree ³, Jenny S. Jiang ⁴, Mathew Cheung ⁵, Carlos F. Bechara ⁶ and Peter H. Lin ^{1,5,*} 

Ultrasonographic Assessment of Arterial Cross-sectional Area in the Thoracic Outlet on Postural Maneuvers Measured With Power Doppler Ultrasonography in Both Asymptomatic and Symptomatic Populations

Xavier Demondion, MD, Clément Vidal, MS, Pascal Herbinet, MD, Corinne Gautier, MD, Bernard Duquesnoy, MD, Anne Cotten, MD

Angiology. 1980 Aug;31(8):538-41.

Thoracic outlet arterial compression: prevalence in normal persons.

Gergoudis R, Barnes RW.

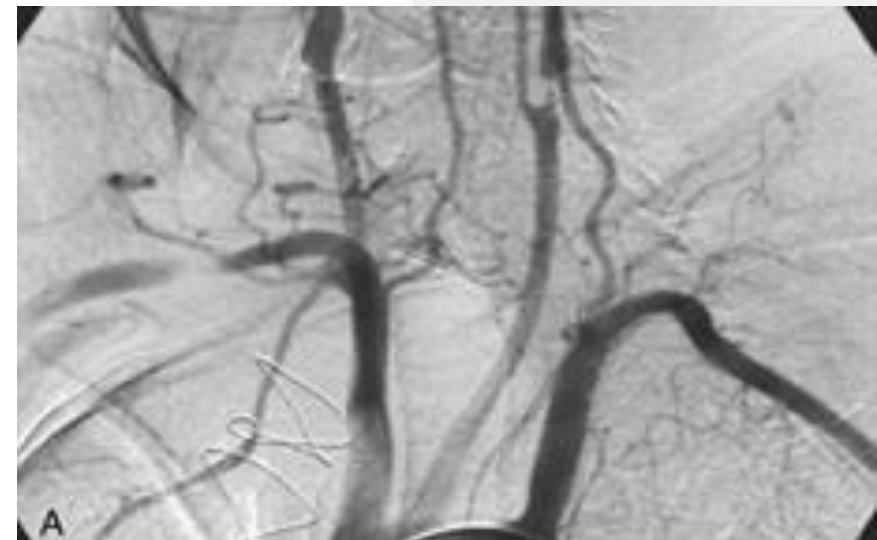
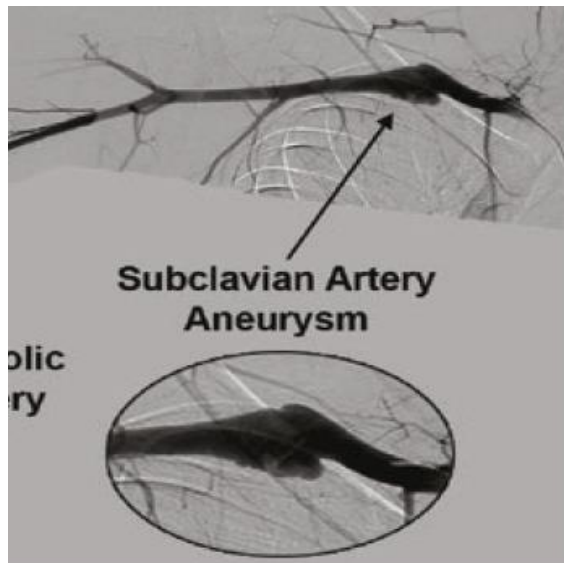
Verwarring rondom ATOS



MAAR!

1. STENOSE VAN DE A. SUBCLAVIA TIJDENS ELEVATIE VAN DE ARM
IS GEEN TOS

Aneurysma/occlusie/gefixeerde stenose = ATOS



Verwarring rondom ATOS



MAAR!

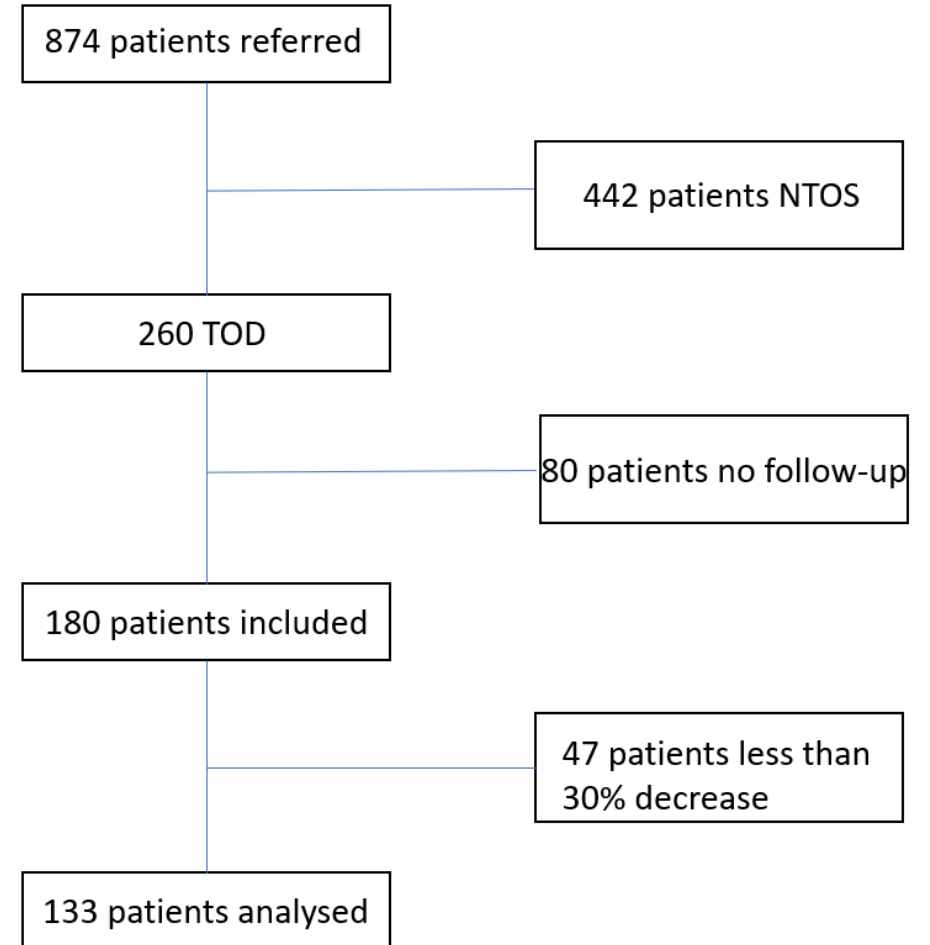
**2. STENOSE VAN DE A. SUBCLAVIA OP DUPLEX HEEFT GEEN
WAARDE**

Duplex



Duplex Ultrasound Studies Are Neither Necessary or Sufficient for the Diagnosis of Neurogenic Thoracic Outlet Syndrome

Jens Goeteyn,¹ Niels Pesser,¹ Marc R.H.M. van Sambeek,^{1,2} Robert W Thompson,³ Bart F.L van Nuenen,⁴ and Joep A.W. Teijink,^{1,5} Eindhoven, The Netherlands; St. Louis, MO; Maastricht, The Netherlands



Duplex

Table II. Summary of symptomatology possibly caused by arterial compression

History & clinical assessment		
Color changes fingers/hand	40/133	30,10%
Temperature changes fingers/hand	31/133	23,30%
Edema fingers/hand	19/133	14,30%
Color changes fingers/hand during EAST	32/133	24,10%
Temperature changes fingers/hand during EAST	16/133	12%
“Arterial” symptoms (yes if one of above positive)	49/133	36,80%

Duplex

- CATHARINA RESEARCH

Table III. Overview of aberrant findings on duplex ultrasound comparing variation in peak systolic velocity (PSV) and occlusion of the of the subclavian artery during provocative maneuvers

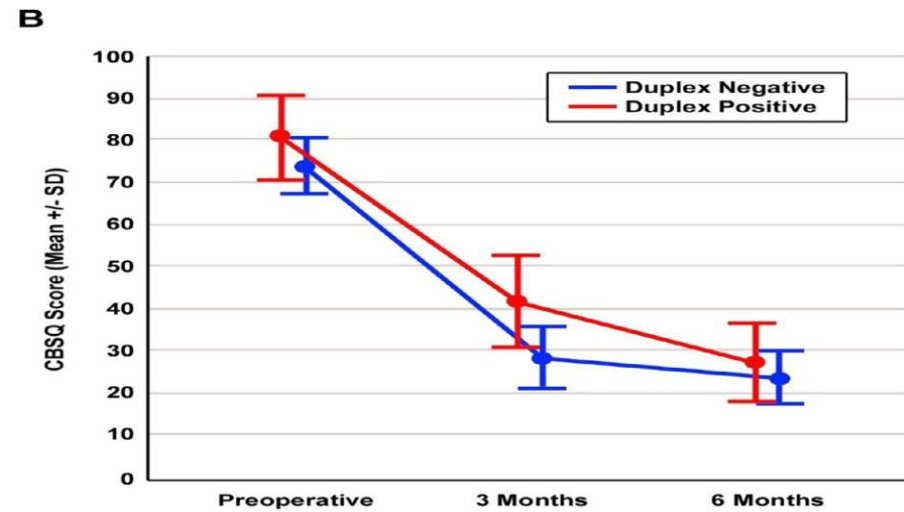
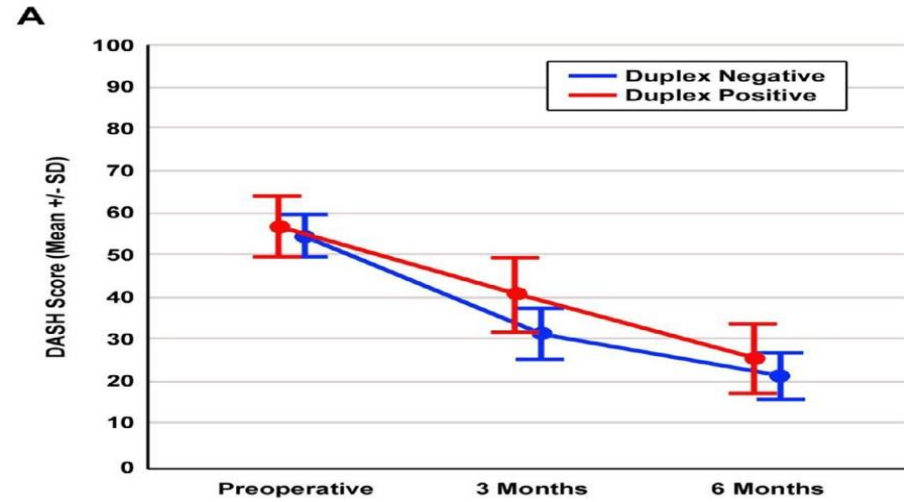
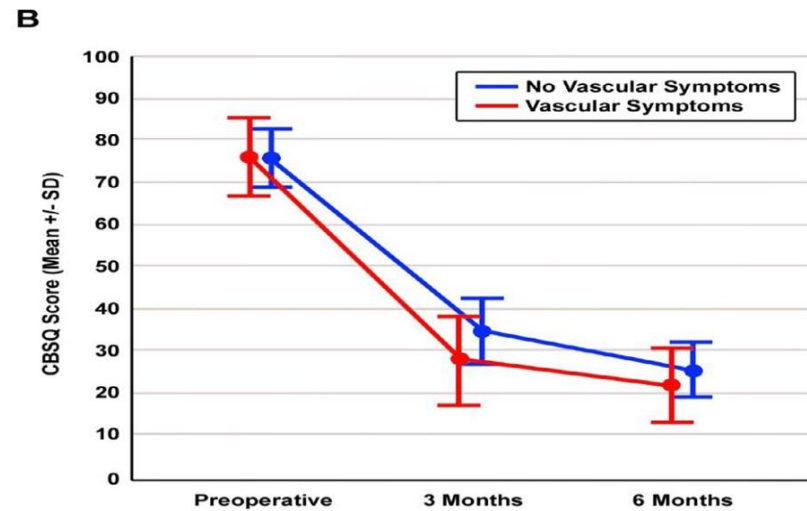
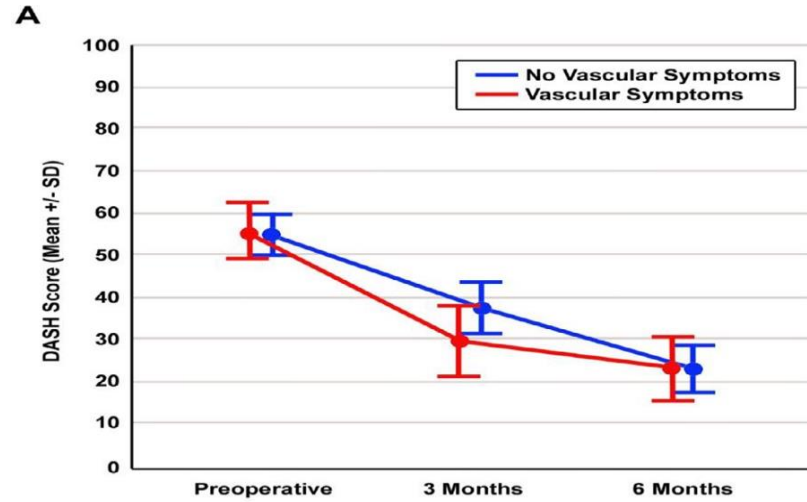
Duplex ultrasound		
50% variation in PSV 0-90-180°	51/133	38,30%
Occlusion 0-90-180°	11/133	8,30%

Table IV. Overview of absolute numbers of patients with “arterial symptoms” and abnormal findings on duplex ultrasound

	Duplex aberrant NO	Duplex aberrant YES	Total
“Arterial symptoms” NO	54	30	84
“Arterial symptoms” YES	28	21	49
Total	82	51	133

A X²-test was performed with $P = 0.414$.

Duplex

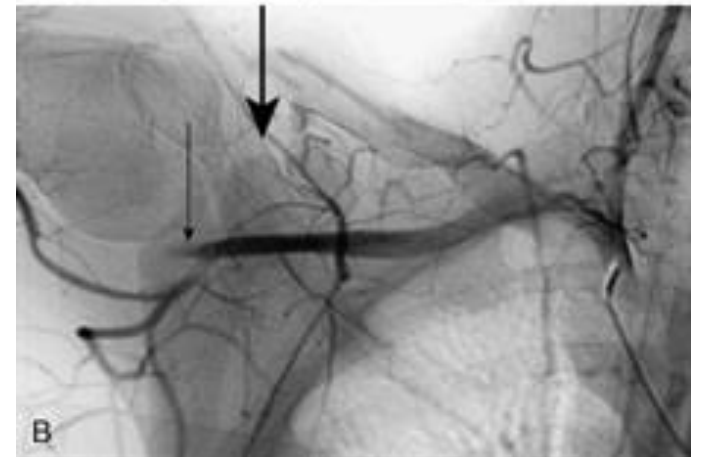
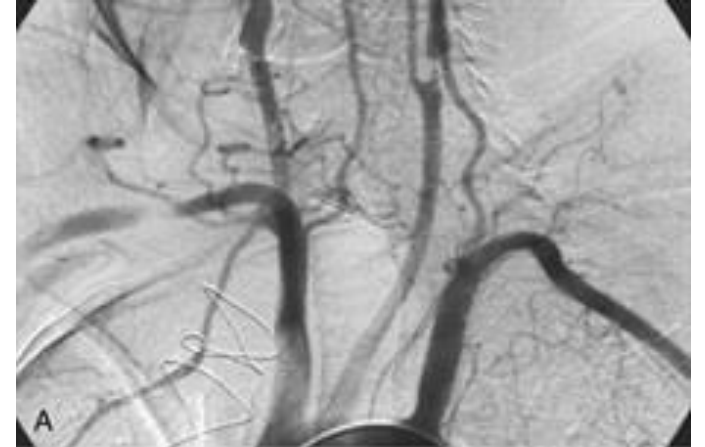


Verwarring rondom ATOS

Definitie ATOS

- Symptomatische ischemie (of)
 - Objectieve schade A. Subclavia (stenose, aneurysma)
 - In combinatie met anatomische varianten
-
- **Verkleuring/temperatuur verschil/...**
≠ ATOS !!
 - Raynaud, OS stimuli, ...

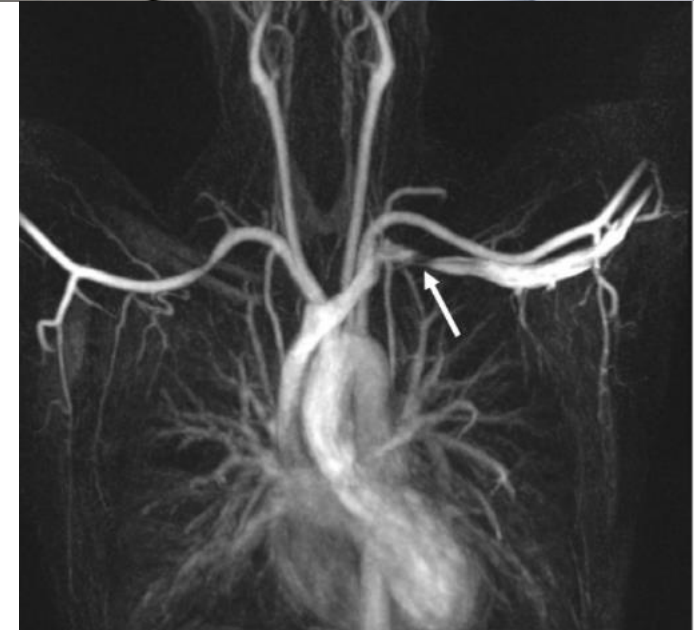
NTOS



Arteriële TOS: diagnostiek



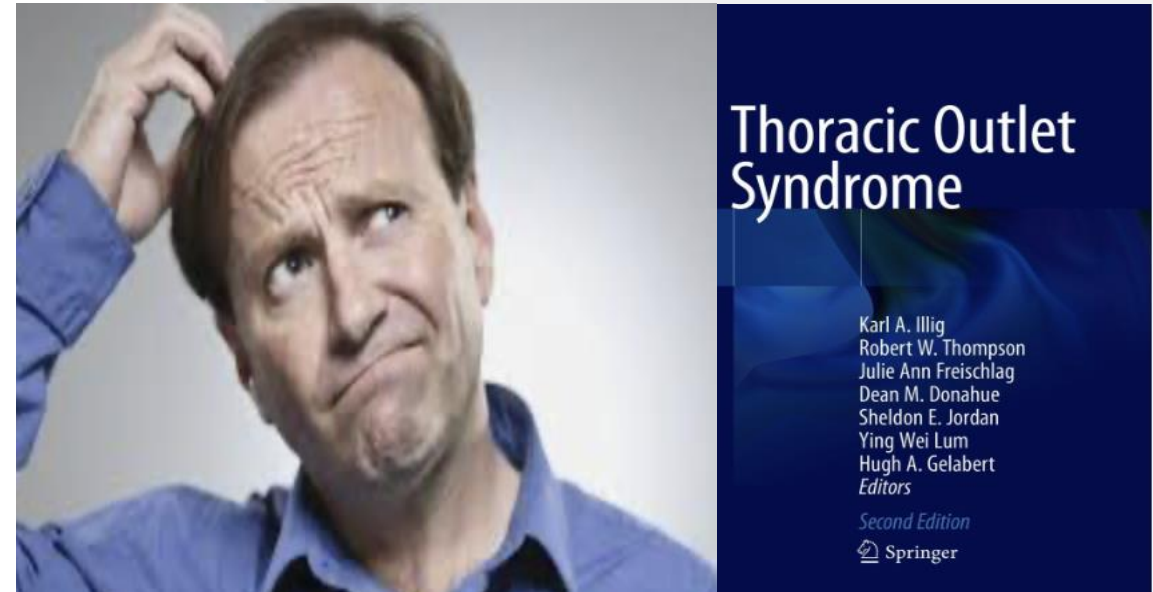
- Duplex dan maar niet?
 - Als je iets ziet = dan toch nog aanvullende beeldvorming nodig
 - Als je niets ziet = dan toch nog aanvullende beeldvorming nodig
- CTA vaak nuttig
 - Arterieel goed in beeld
 - Beenderige abnormaliteiten in beeld (veel frequenter dan V & NTOS)
- MRA
 - Kan zeker
 - Minder informatie over trombusload, calcificaties, beenderige structuren



Arteriële TOS



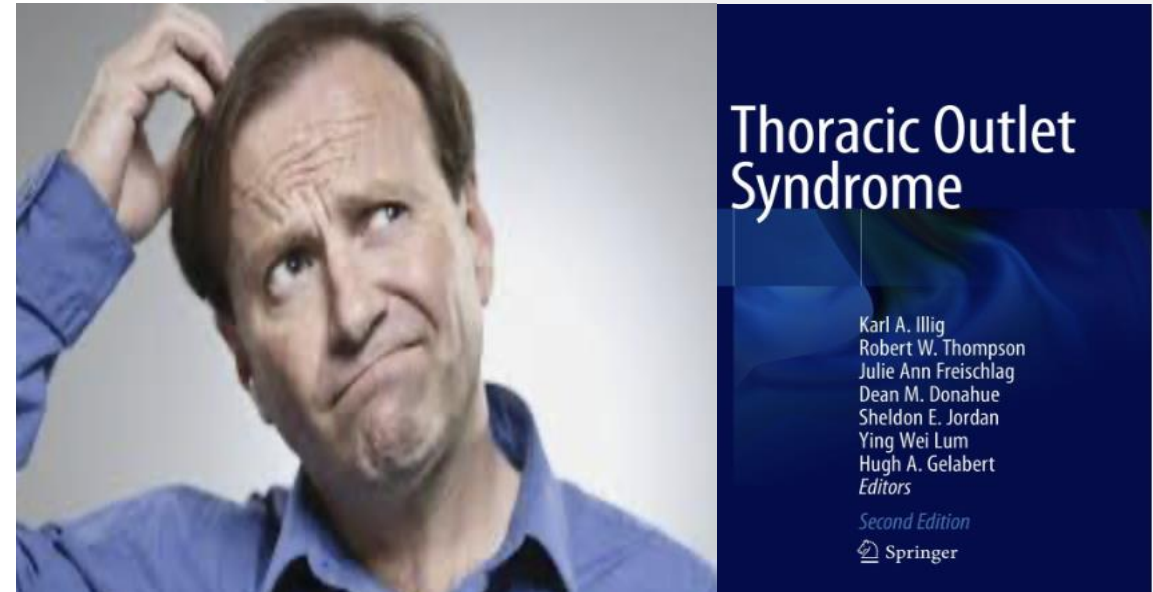
- Wetenschappelijke publicaties
 - Weinig
 - Retrospectief
 - Kleine series van de afgelopen 20-30 j
 - Diagnose 'ATOS'
 - Te vertrouwen?
 - Outcome parameters
 - Variabel
 - Vaak uitgevonden door auteur zelf



Arteriële TOS



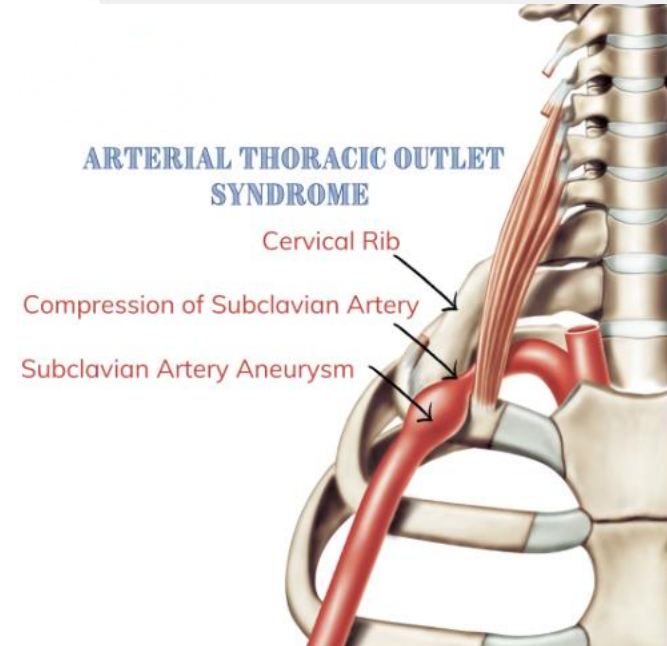
- Wetenschappelijke publicaties
 - Veel bias
 - Weinig te vertrouwen
- **MAAR**
 - **ENKELE BELANGRIJKE PRINCIPES DIE GEHONOREERD MOETEN WORDEN !**



ATOS: Principes van behandeling



- 3 problemen behandelen:
 - Oorzaak behandelen
 - Beenderige afwijkingen
 - Fibrotische banden
 - Schade aan A subclavia behandelen
 - Igv aneurysma: resectie en interponaat
 - Buigpunt van de arm
 - Rekening mee houden!

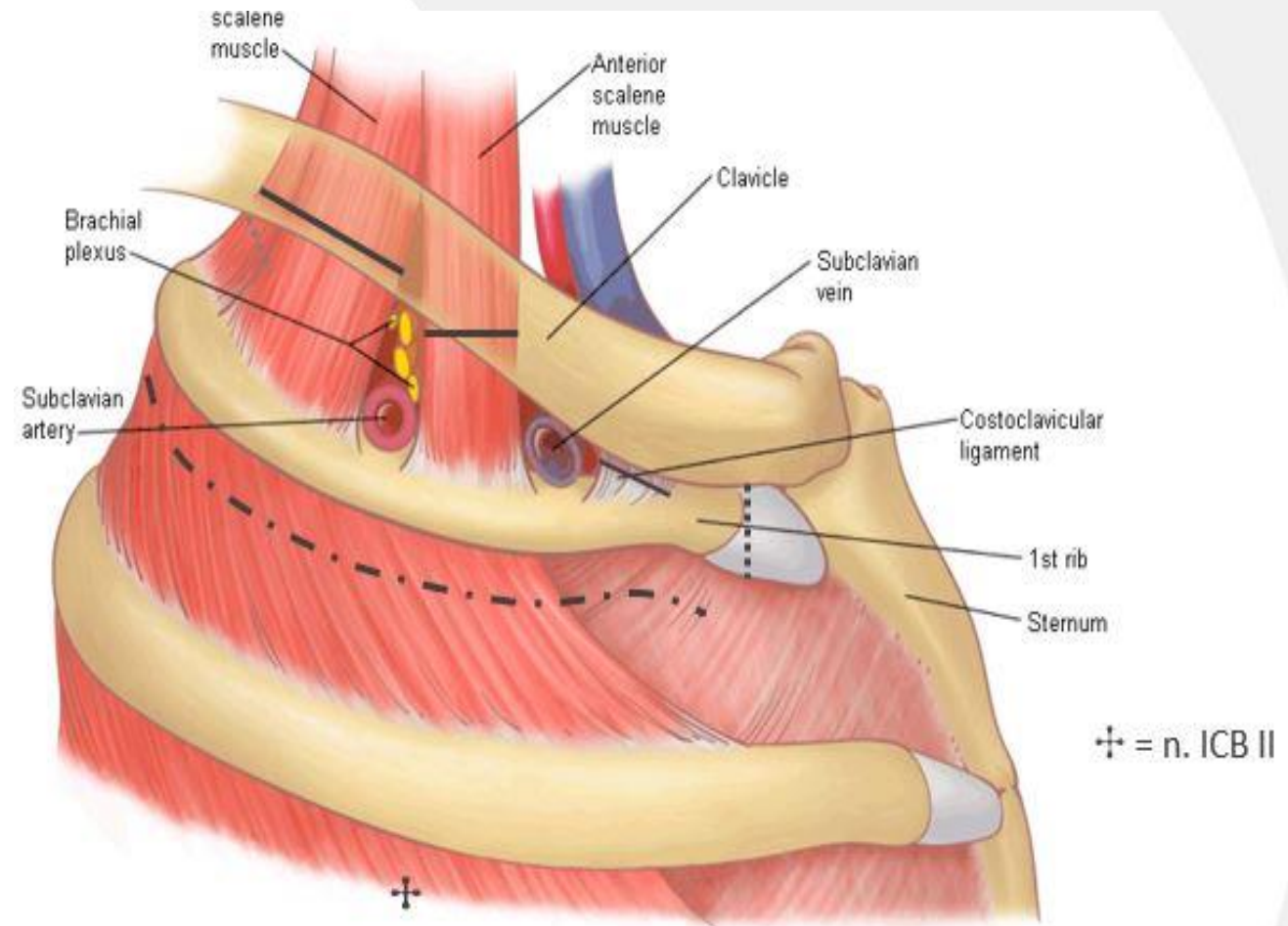


Operatief ingrijpen

TOD: thoracic outlet decompressie



- TOD =
 - VOLLEDIGE eerste rib resectie
 - Scalenius spier resectie
 - Subclavius/scalenius minimus resectie
 - Pectoralis minor resectie (?)
 - Neurolysis/venolyse/arteriolyse (?)



TOD: thoracic outlet decompressie



- Trans-axillaire thoracic outlet decompressie
 - TA-TOD



TOD: thoracic outlet decompressie



- Trans-axillaire thoracic outlet decompressie
 - TA-TOD
- Supraclaviculaire thoracic outlet decompressie
 - SC-TOD



TOD: thoracic outlet decompressie



- Trans-axillaire thoracic outlet decompressie
 - TA-TOD
- Supraclaviculaire thoracic outlet decompressie
 - SC-TOD
- Gecombineerde supraclaviculaire als infraclaviculaire thoracic outlet decompressie

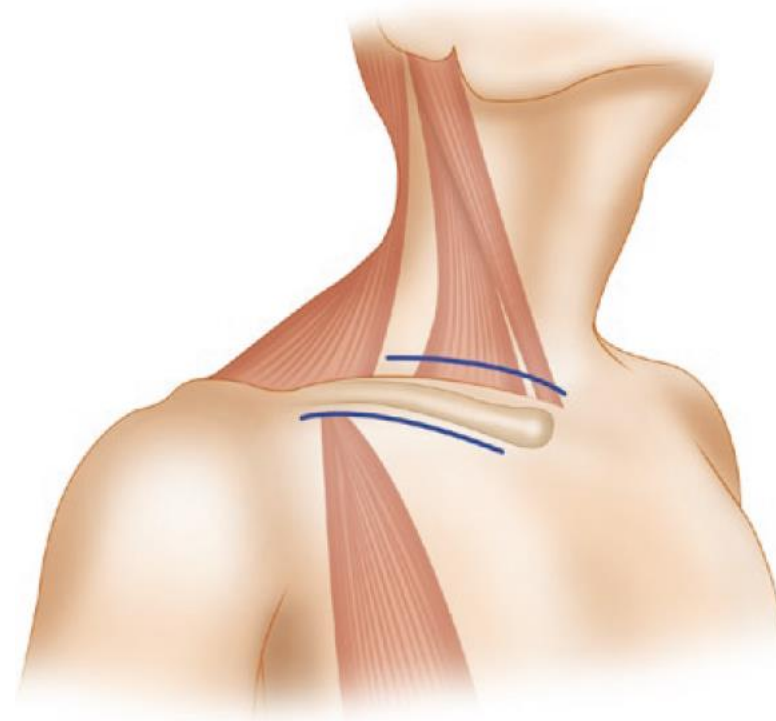


Fig. 92.8 A combined supraclavicular and infraclavicular approach may be necessary for large axillosubclavian artery aneurysms

Trimano



Martin's arm with Deaver-retractor

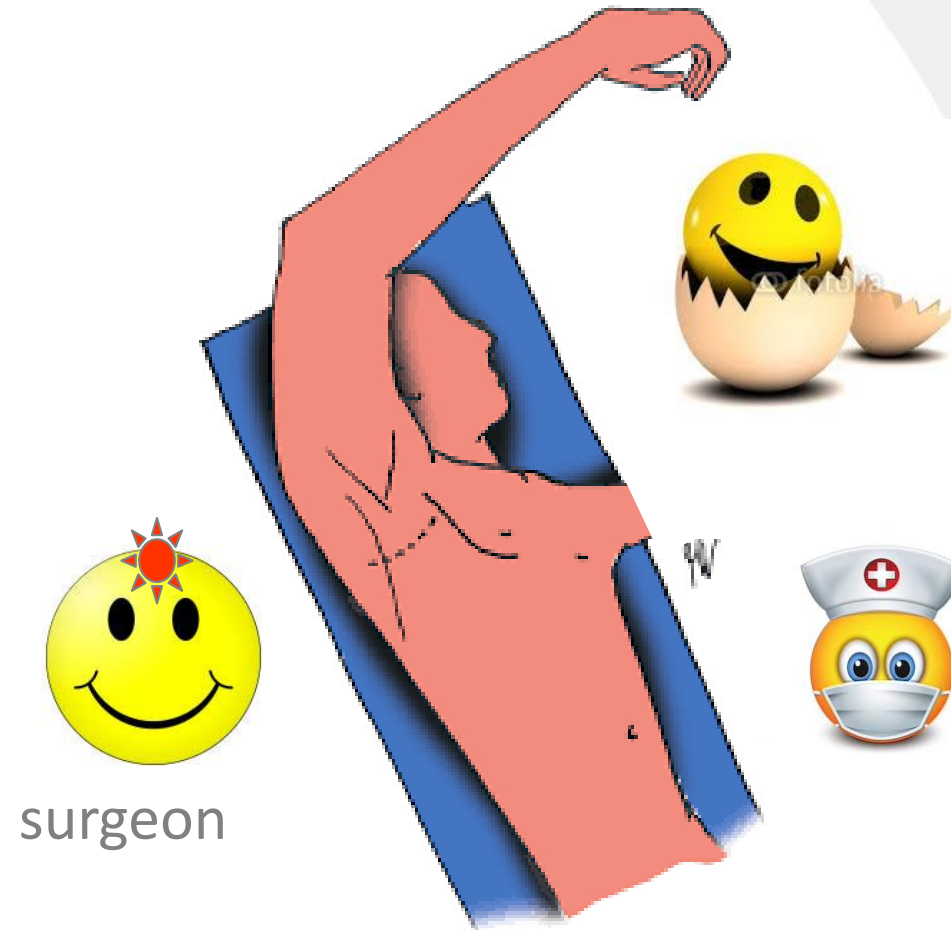


How to TOD!

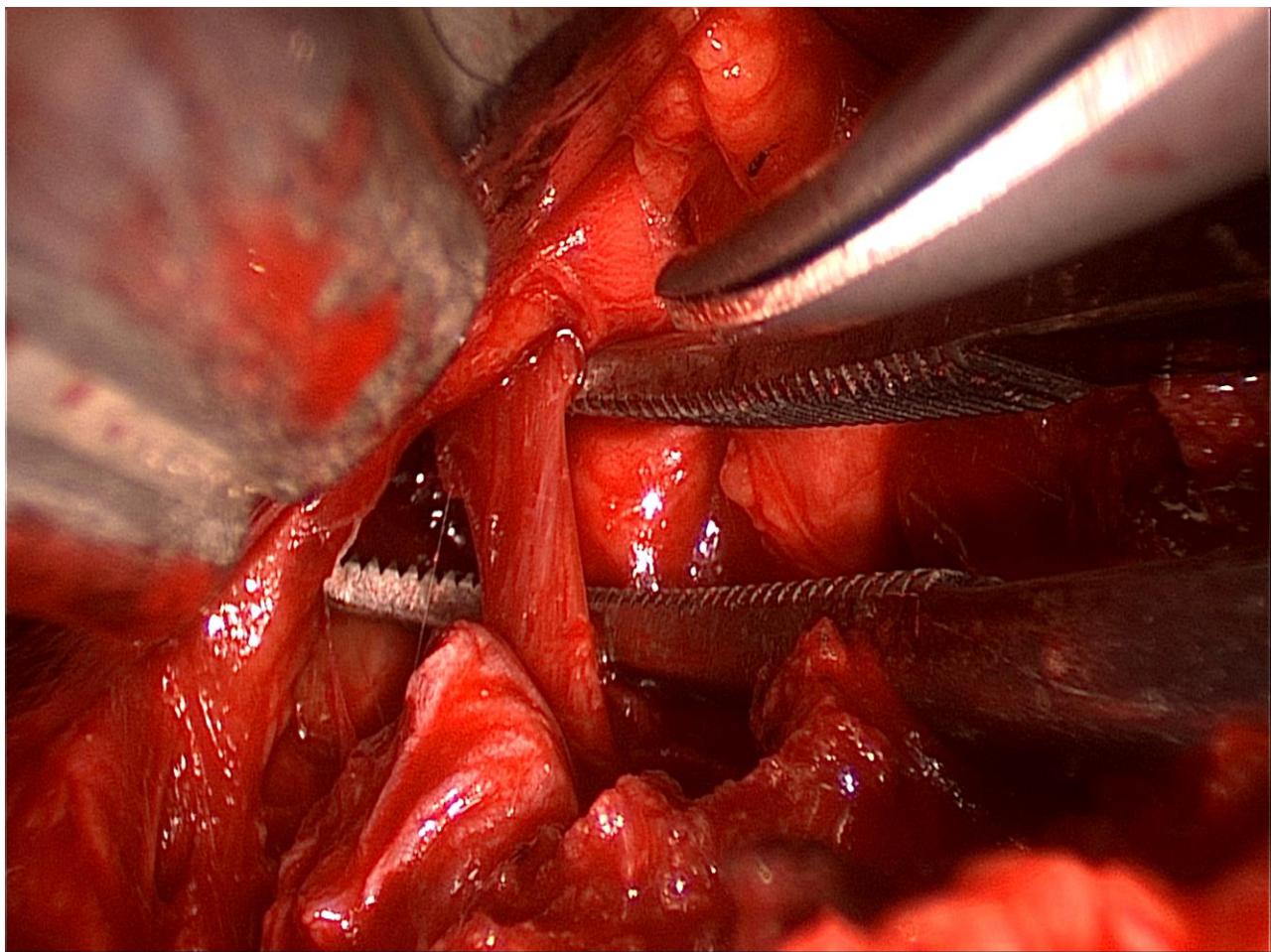
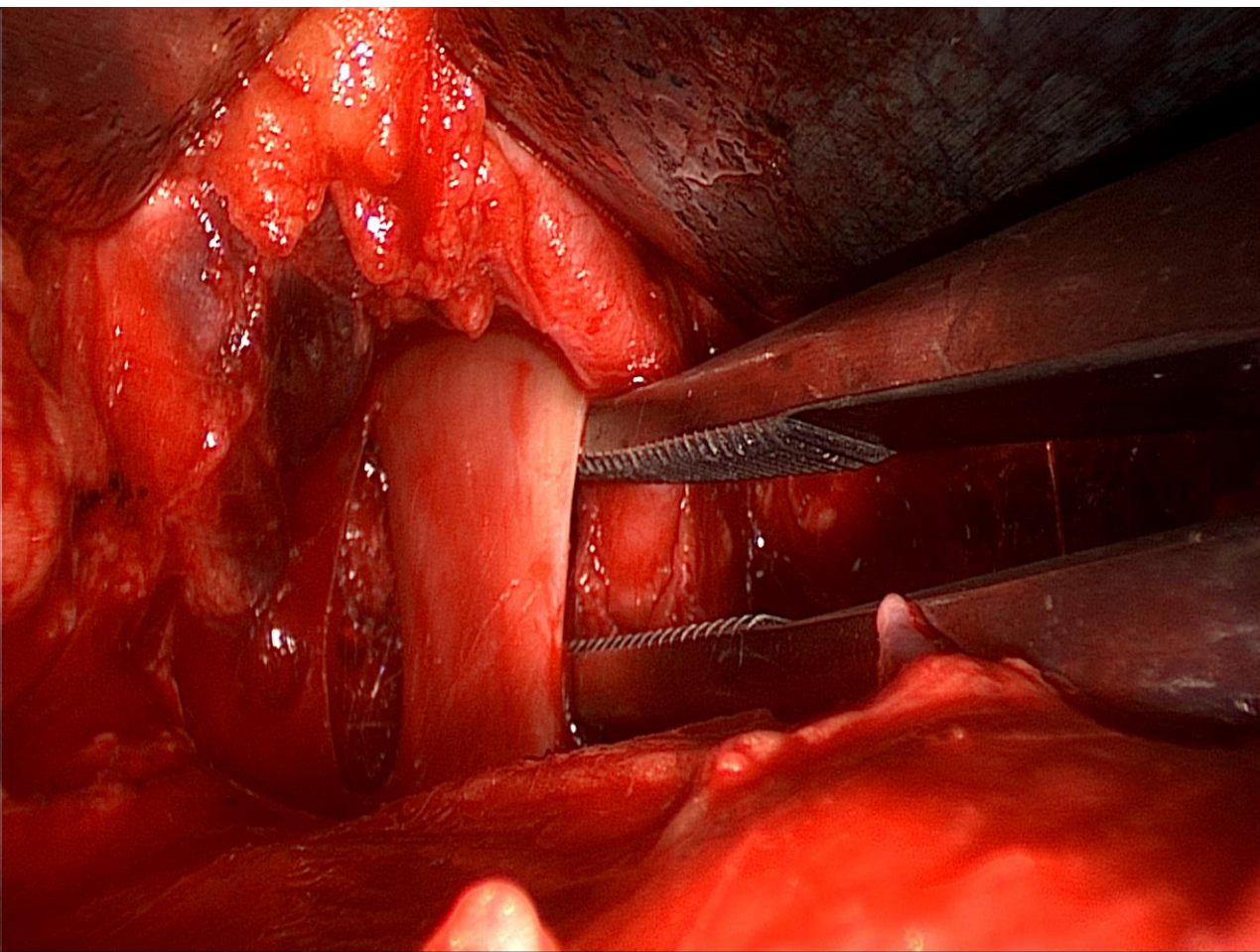


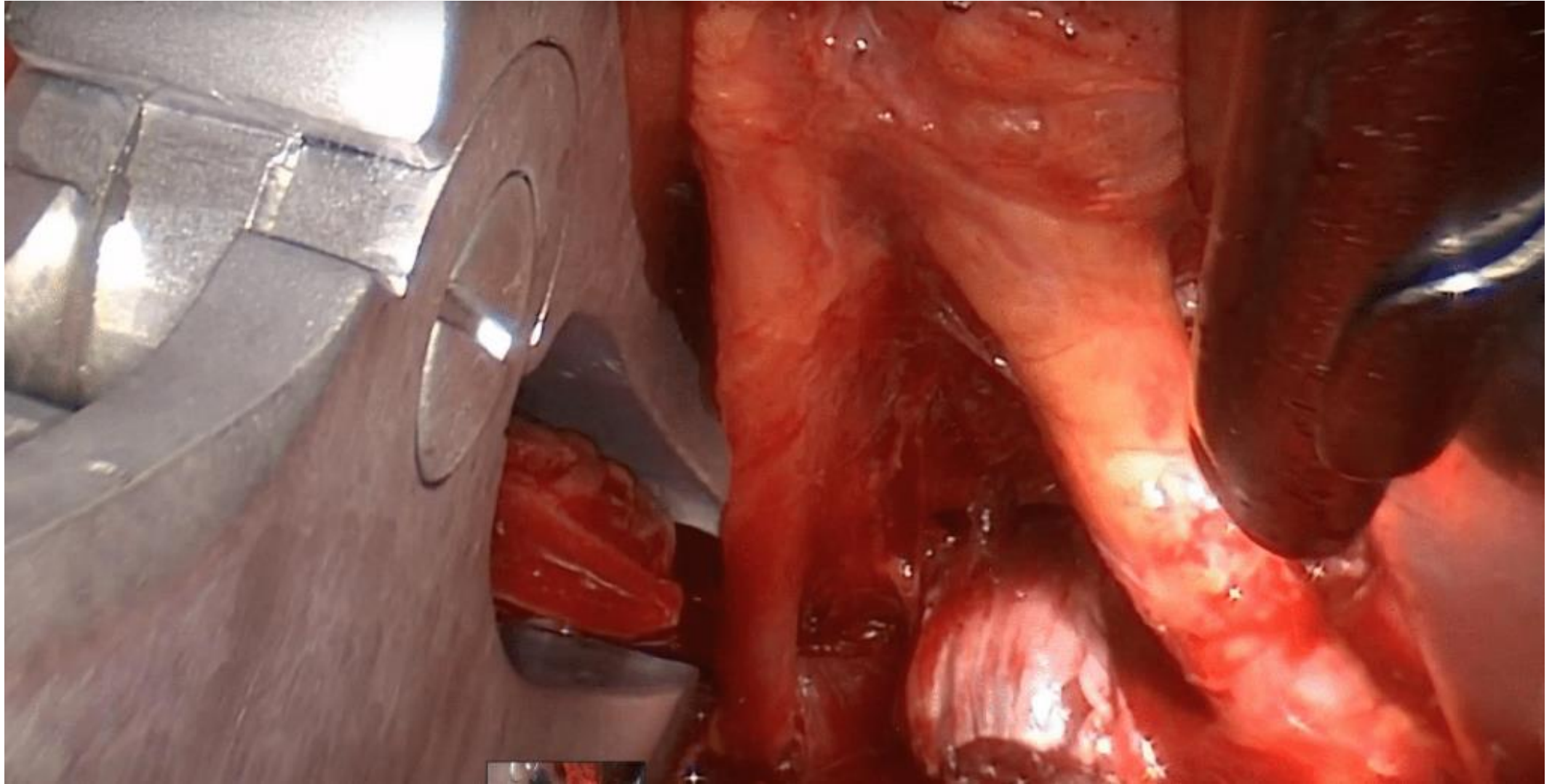
TV screen

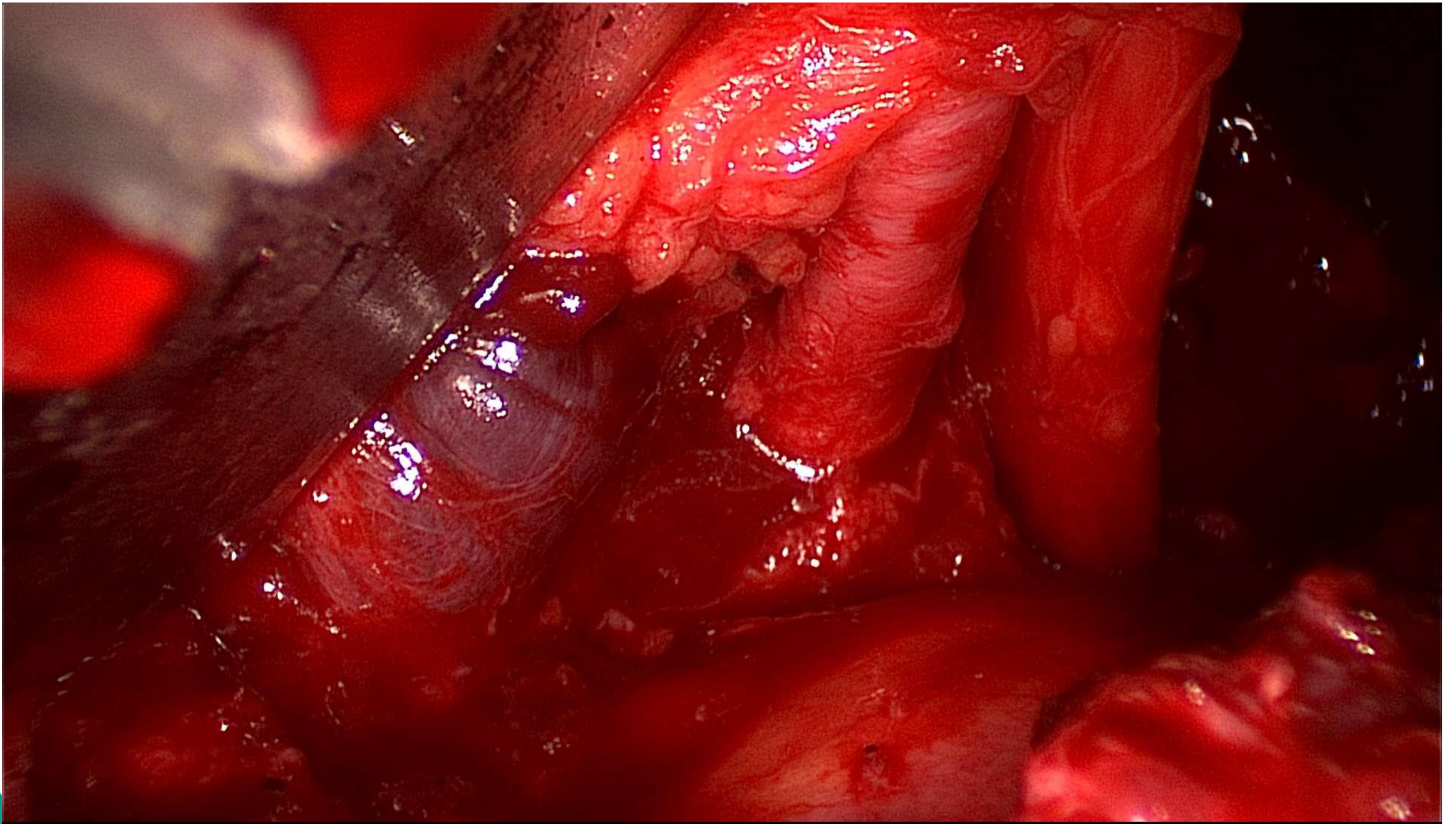
TV screen



surgeon







ATOS: Rol eerste rib?



- ROL VAN DE EERSTE RIB?
 - Oorzaak behandelen
 - Beenderige afwijkingen
 - Fibrotische banden
 - Dogma van NTOS minder van belang
 - (ALLEEN VOLLEDIGE EERSTE RIB RESECTIE)

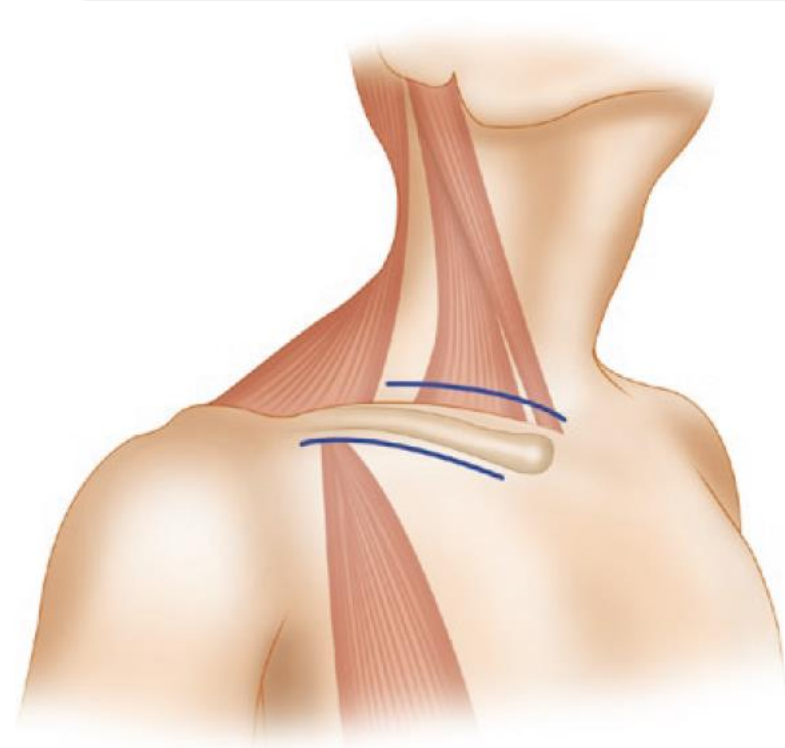
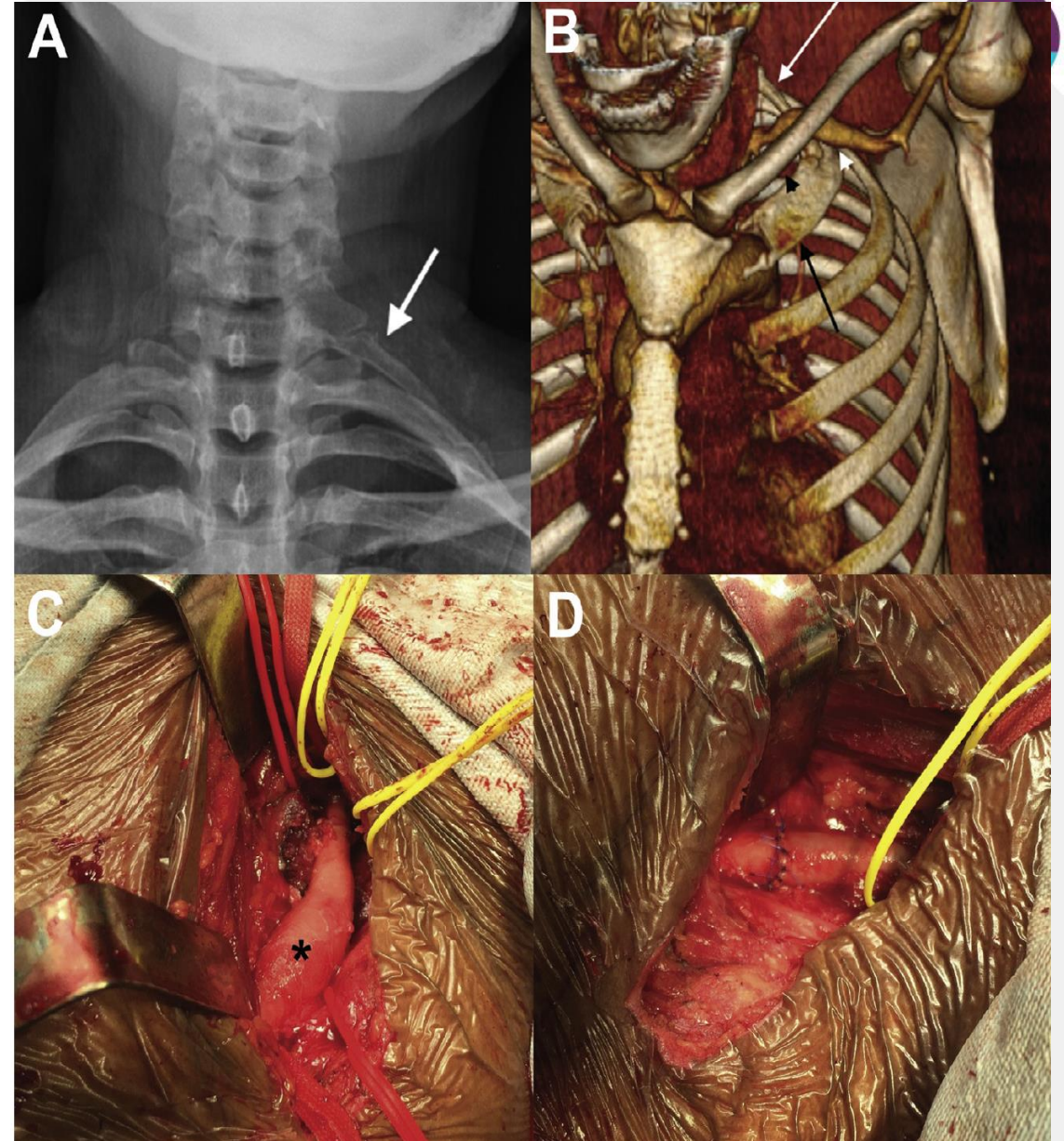


Fig. 92.8 A combined supraclavicular and infraclavicular approach may be necessary for large axillosubclavian artery aneurysms

ATOS: behandeling

- Behandeling afhankelijk van
 - Uitgebreidheid aantasting A. Subclavia
 - Trans-axillair is geen vaatreconstructie mogelijk
 - Anatomische anomalie



ATOS: endovasculair?



- Plaats voor endovasculaire behandeling?
 - Bij acute trombose
 - Trombolyse
 - Thrombectomy devices
 - Penumbra
 - Angiojet
 - » Meer rock & roll, gezien kans op embolen (ook naar carotis)
 - Voor chronische ATOS?
 - Aneurysma repair met gecoverde stents (?)
 - Stent voor occlusie?
 - BUIGPUNT!

Endovascular Reconstruction of Subclavian Artery Aneurysms in Patients with Arterial Thoracic Outlet Syndrome

Meena M. Archie, and Hugh A. Gelabert, Los Angeles, California



Fig. 1. Incidence of subclavian artery aneurysms associated with TOS.

ATOS: endovascular?

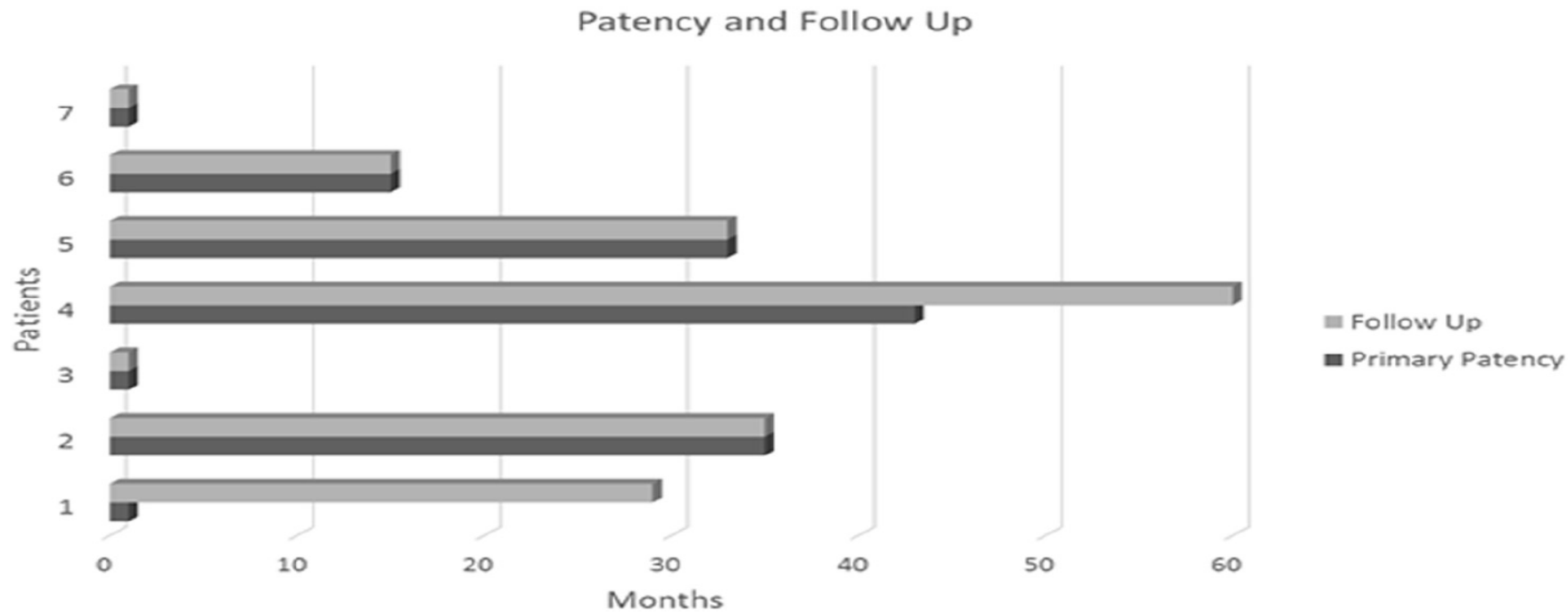


Fig. 4. Primary patency and follow-up interval for each patient. Numbers indicate patient order in this series. The follow-up interval for each patient is noted as a *gray line*. The primary patency for each stent graft is noted as a *black line*.

ATOS: endovascular?

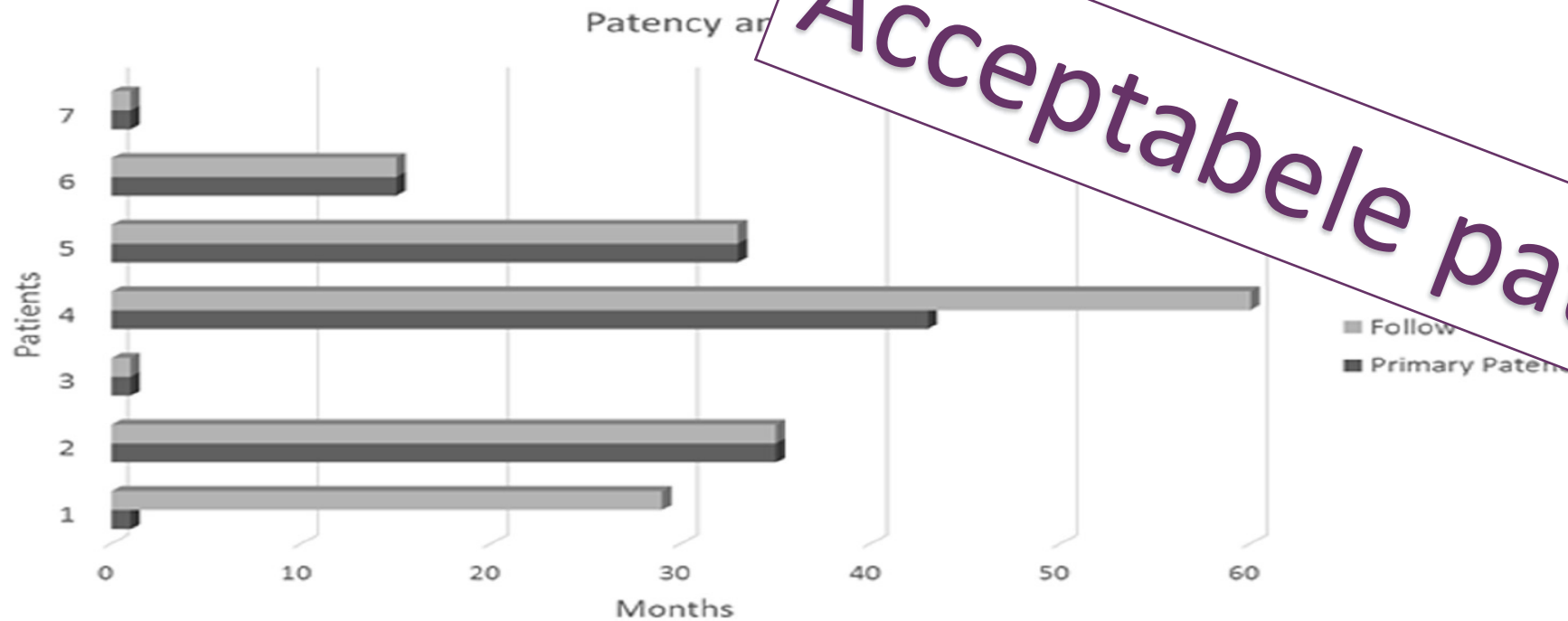
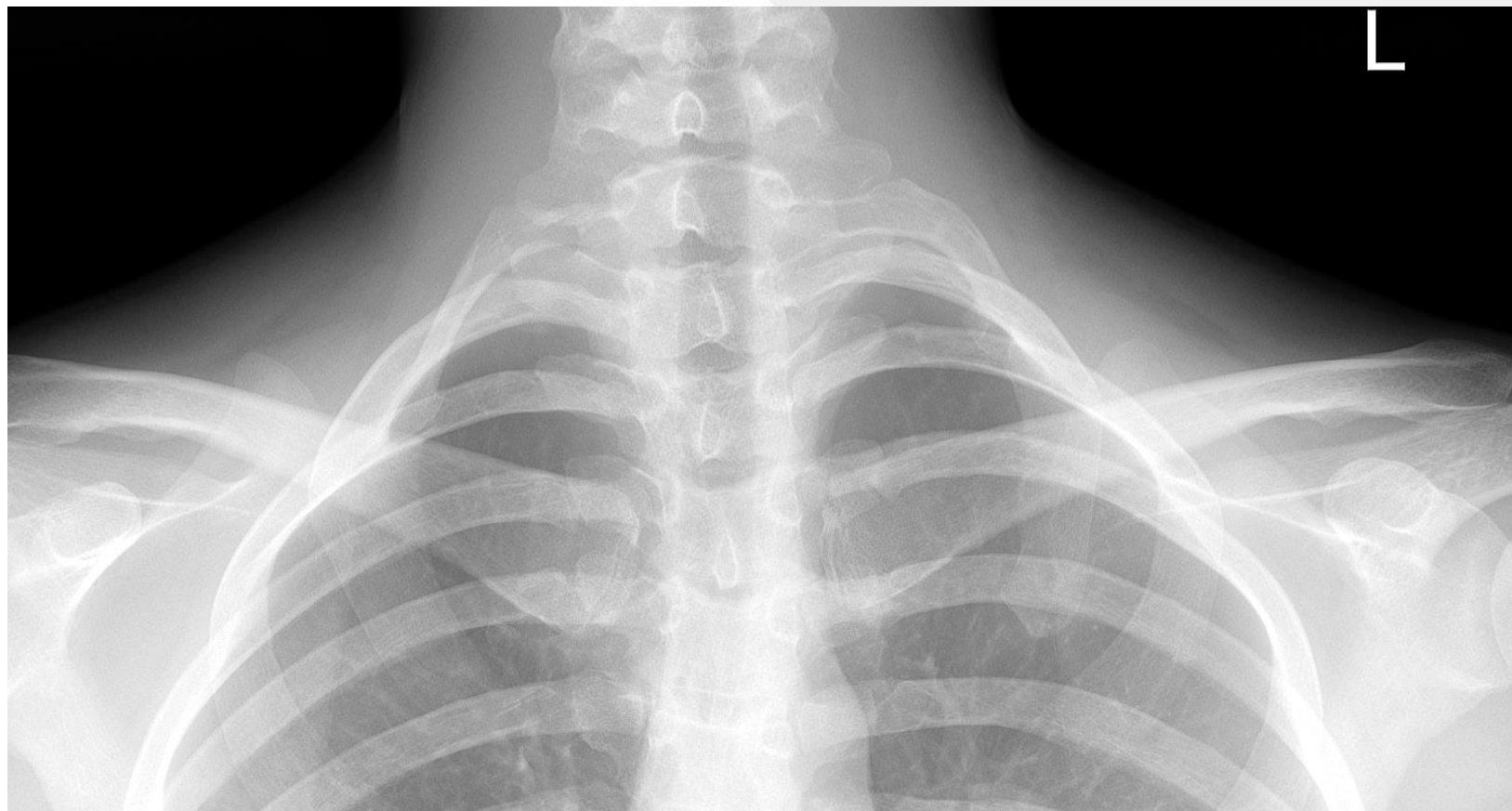


Fig. 4. Primary patency and follow-up interval for each patient. Numbers indicate patient order in this series. The follow-up interval for each patient is noted as a *gray line*. The primary patency for each stent graft is noted as a *black line*.

ATOS: behandeling



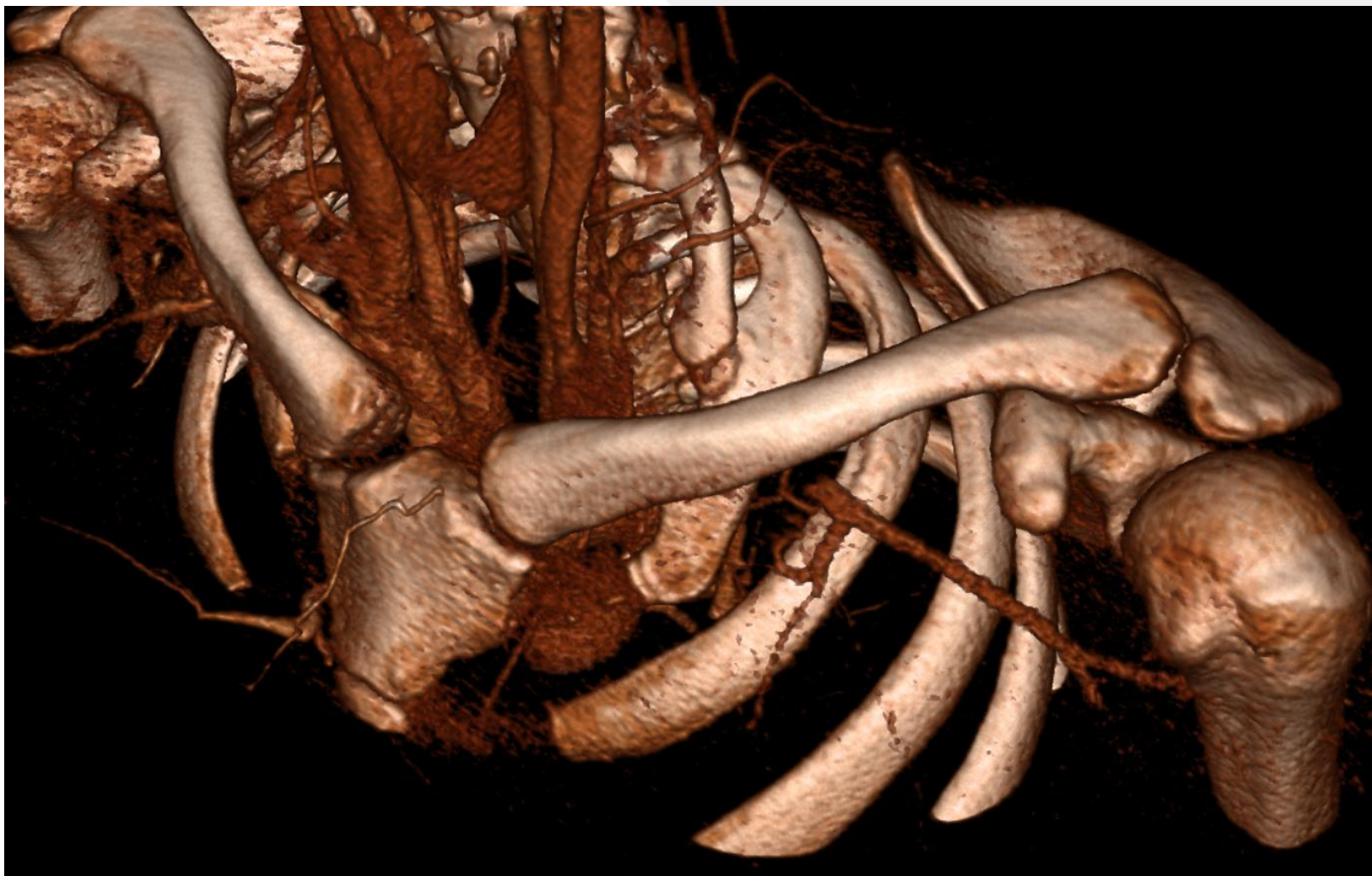
- Casuïstiek
 - Vrouw
 - 18 j
 - Acute ischemie links



ATOS: behandeling



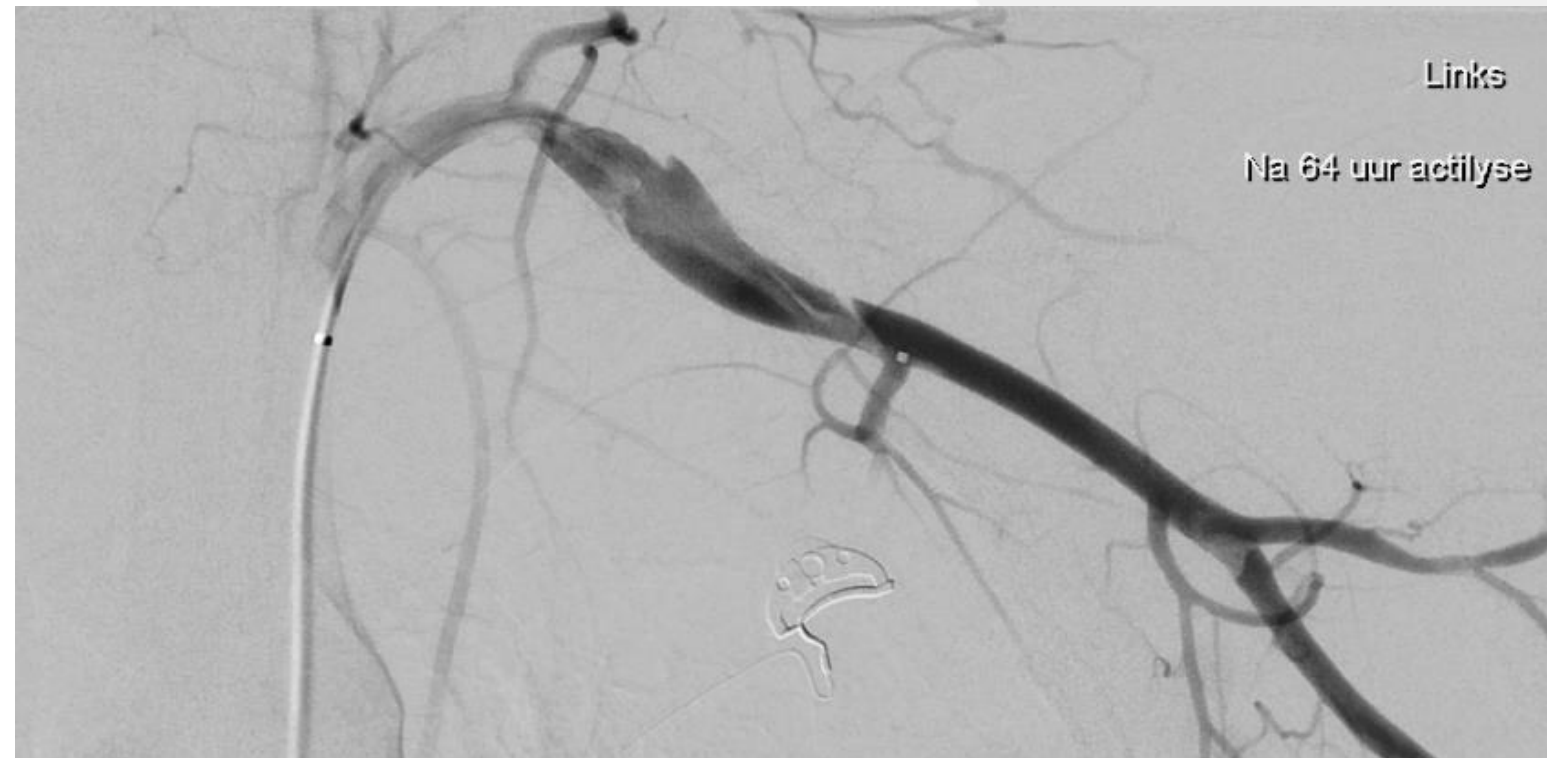
- Casuïstiek
 - Vrouw
 - 18 j
 - Acute ischemie links



ATOS: behandeling



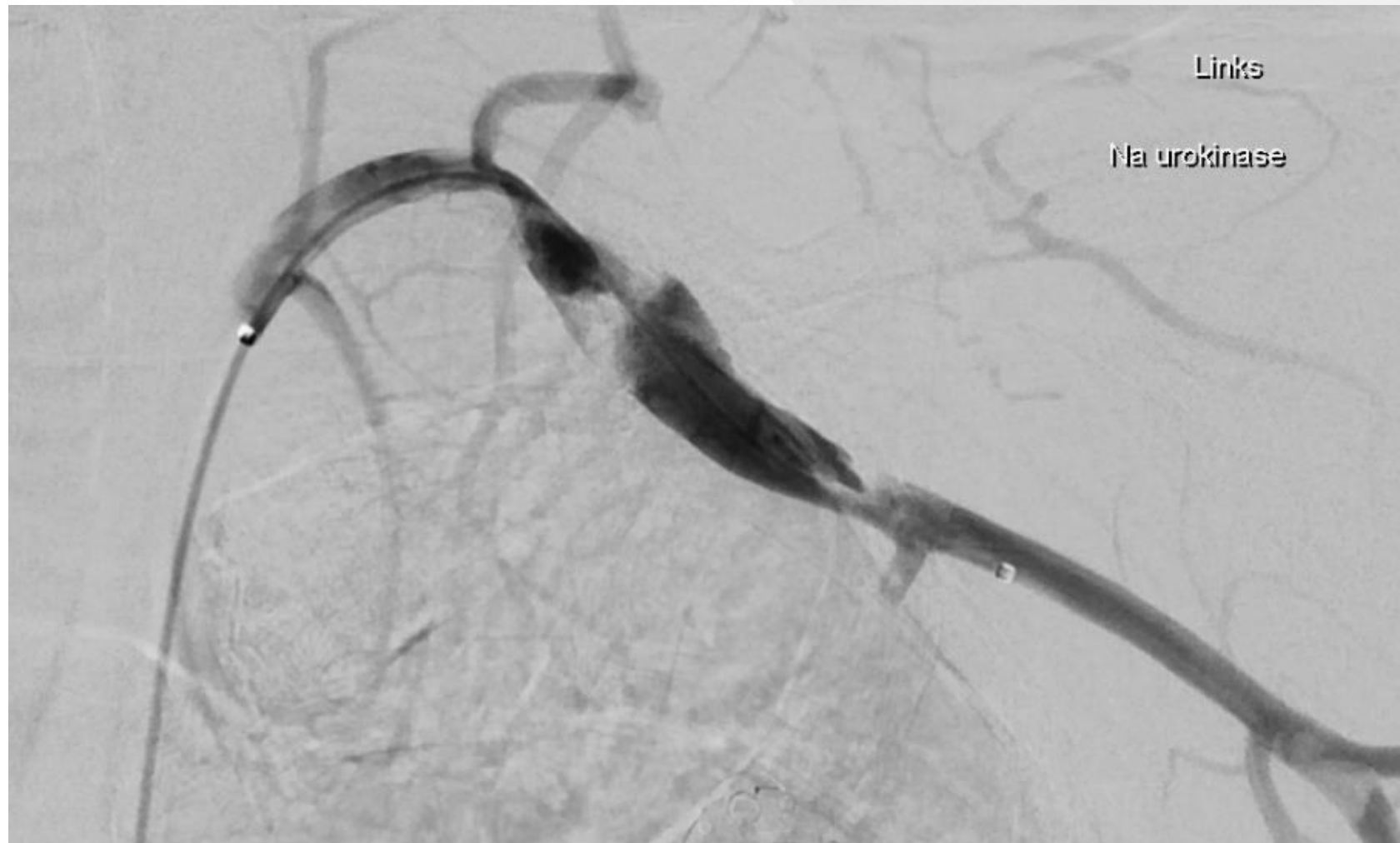
- Casuïstiek
 - Trombolyse



ATOS: behandeling



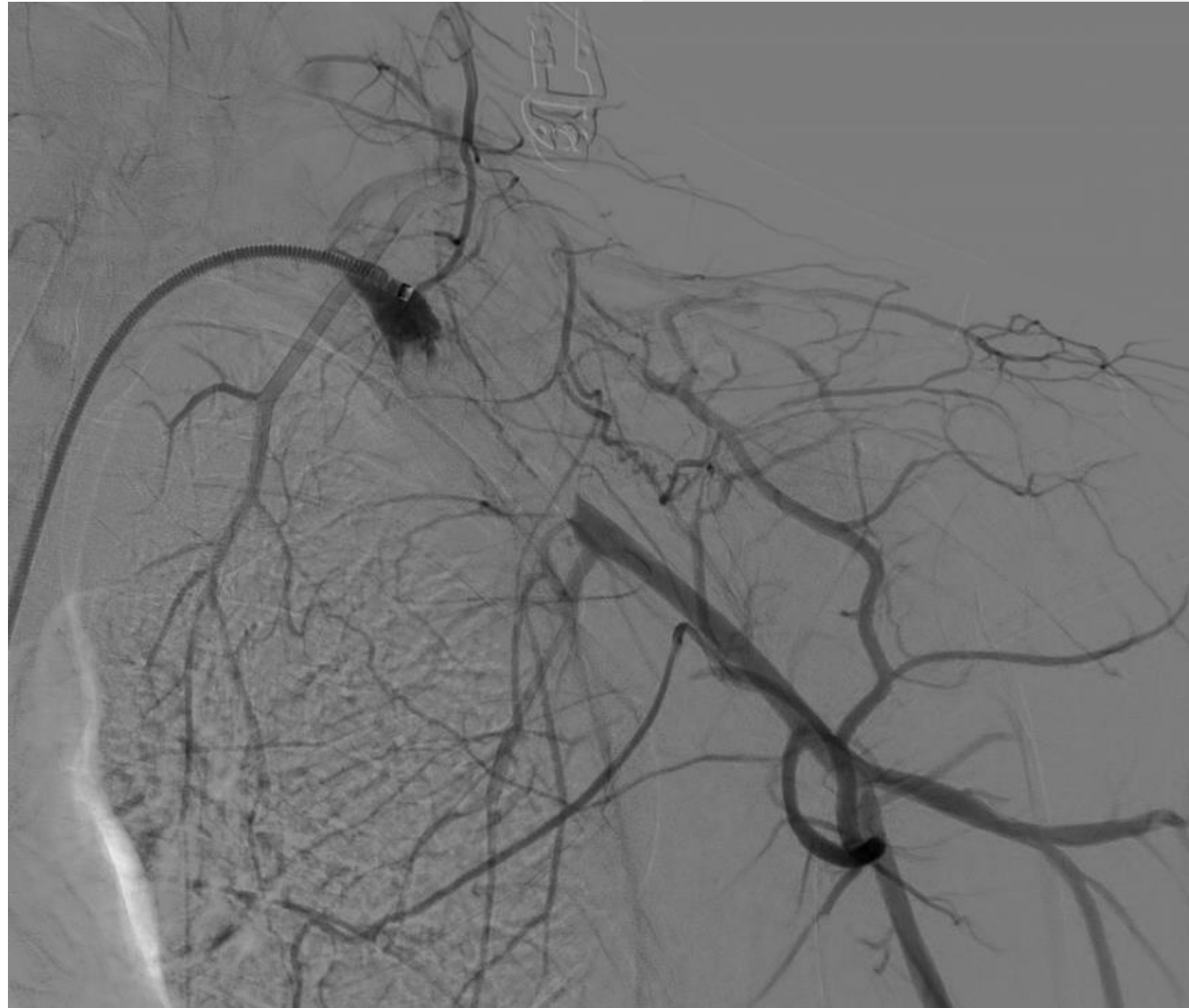
- Casuïstiek
 - Na PTA...



ATOS: behandeling



- Casuïstiek
 - Na TATOD
 - Verwijderen halsrib
 - Helaas....



ATOS: behandeling



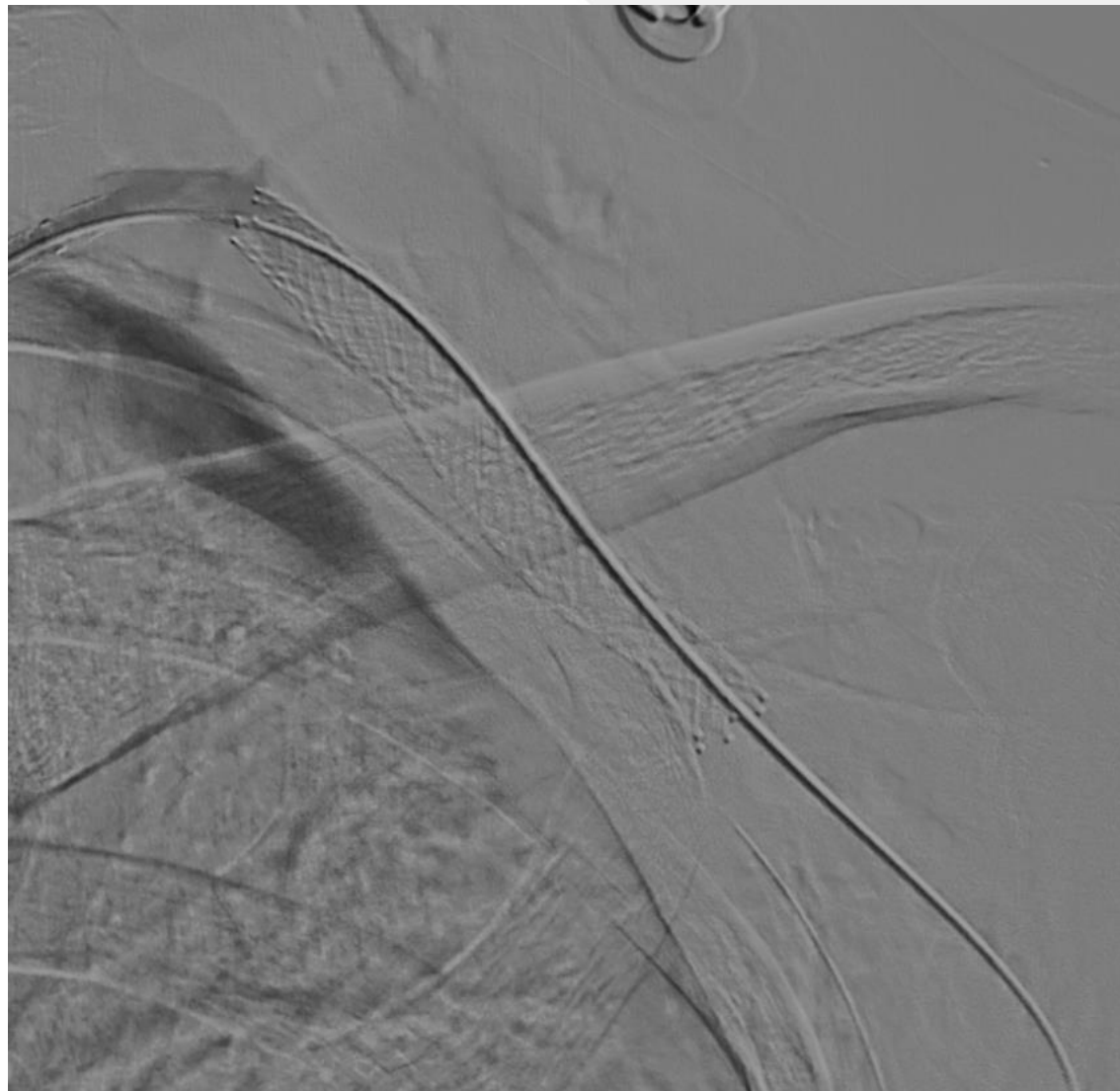
- Casuïstiek
 - Na trombectomie device



ATOS: behandeling



- Casuïstiek
 - Na trombectomie device
 - Stent helaas noodzakelijk



ATOS: behandeling



- Casuïstiek
 - Na trombectomie device
 - Stent helaas noodzakelijk

7j later: stent goed open!

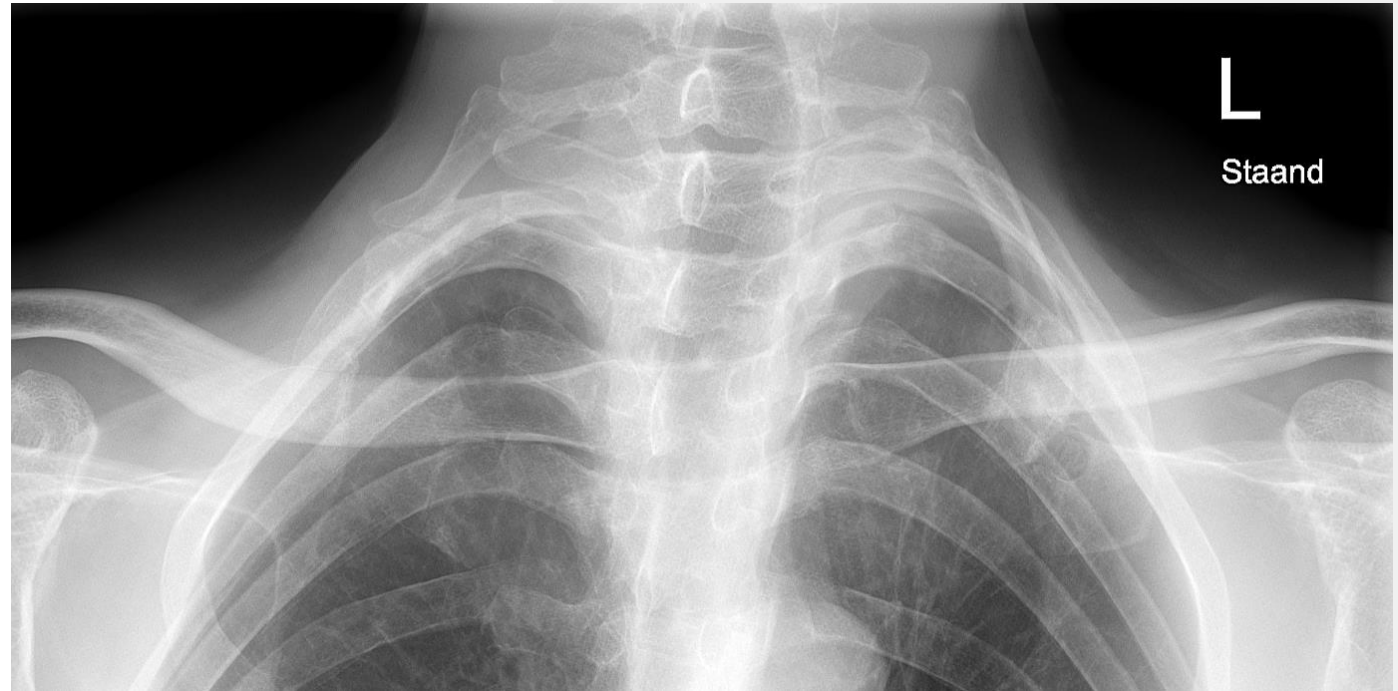


ATOS: behandeling



■ Casuïstiek

- Veel klachten rechter arm
 - Pijn
 - Dof gevoel vingers
 - Regelmatig krampen
 - Hand iets roder



ATOS: behandeling



■ Casuïstiek

- Veel klachten rechter arm
 - Pijn
 - Dof gevoel vingers
 - Regelmatig krampen
 - Hand iets roder



ATOS: behandeling



■ Casuïstiek

- Veel klachten rechter arm
 - Pijn
 - Dof gevoel vingers
 - Regelmatig krampen
 - Hand iets roder
- CTA: occlusie subclavia
 - ??

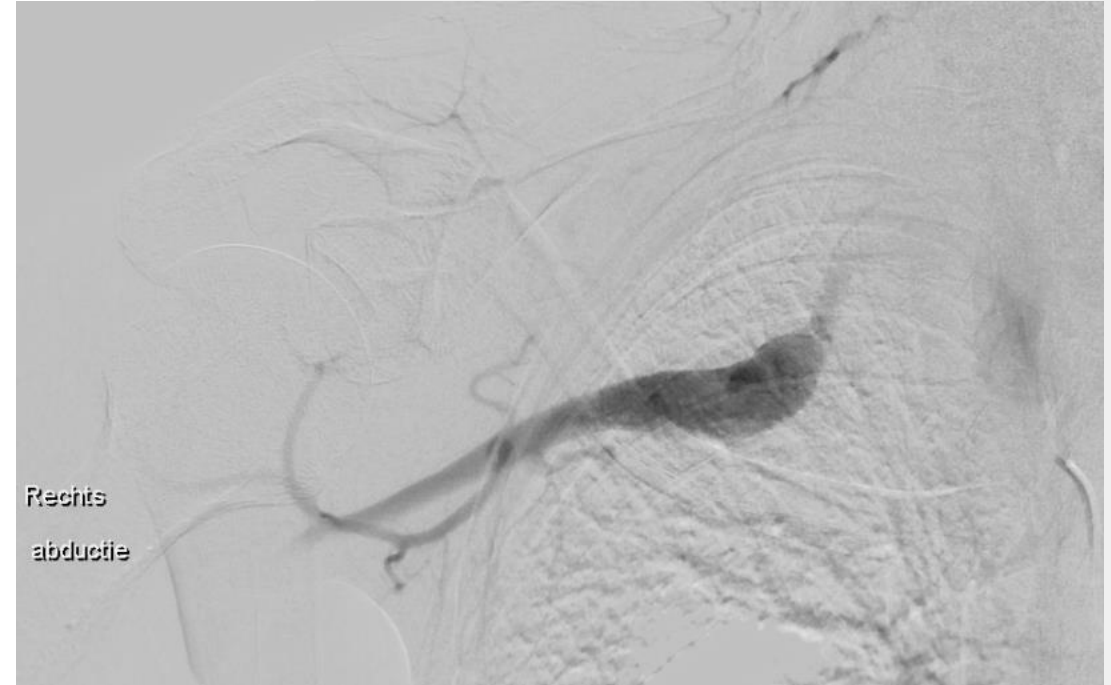


ATOS: behandeling



■ Casuïstiek

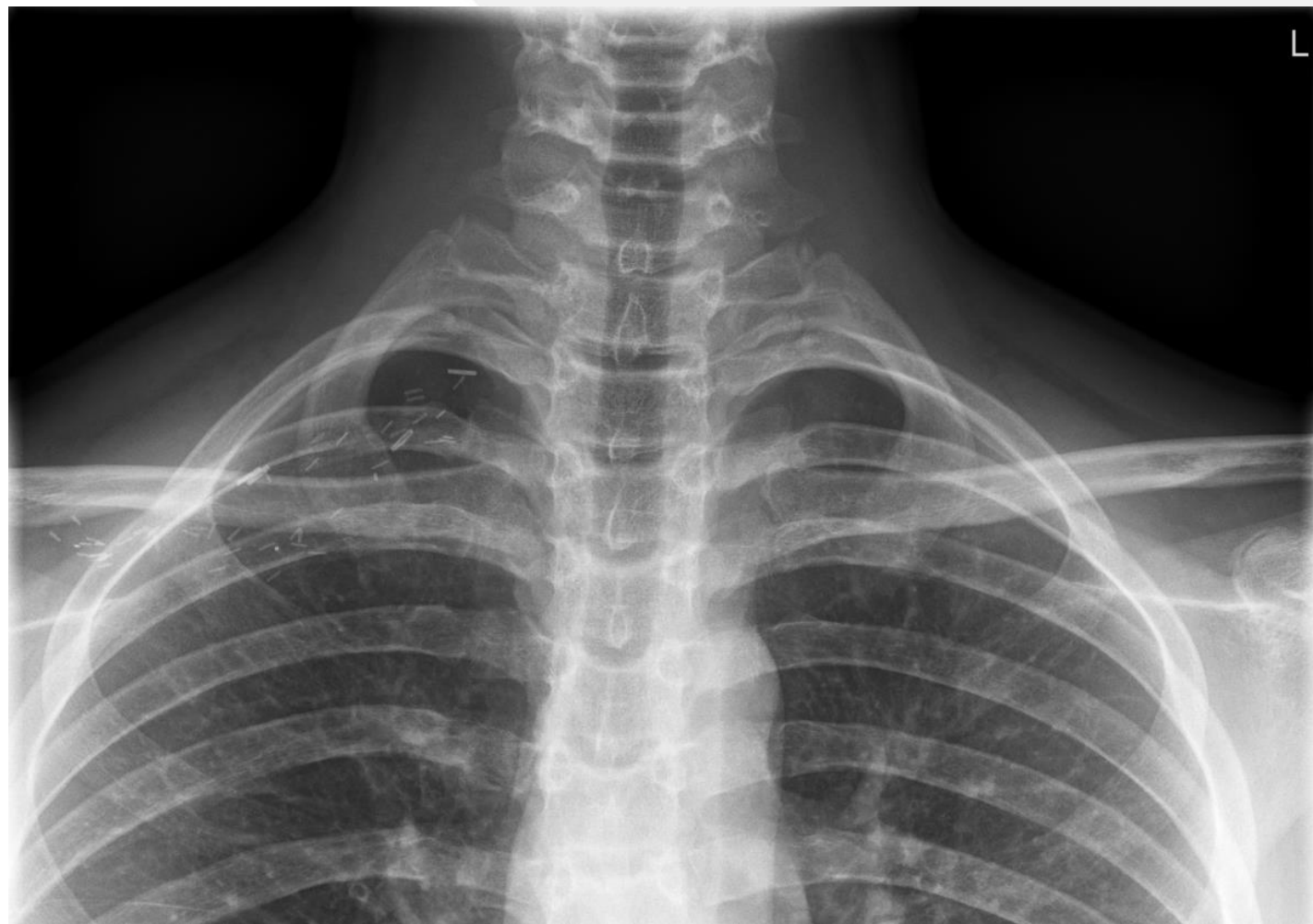
- Veel klachten rechter arm
 - Pijn
 - Dof gevoel vingers
 - Regelmatig krampen
 - Hand iets roder
- TATOD met resectie halsrib
- GEEN behandeling aneurysma



ATOS: behandeling



- Casuïstiek
 - 14j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 19j: al 3 x PTA gehad wegens restenose



ATOS: behandeling



- Casuïstiek
 - 14j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 19j: al 3 x PTA gehad wegens restenose



ATOS: behandeling

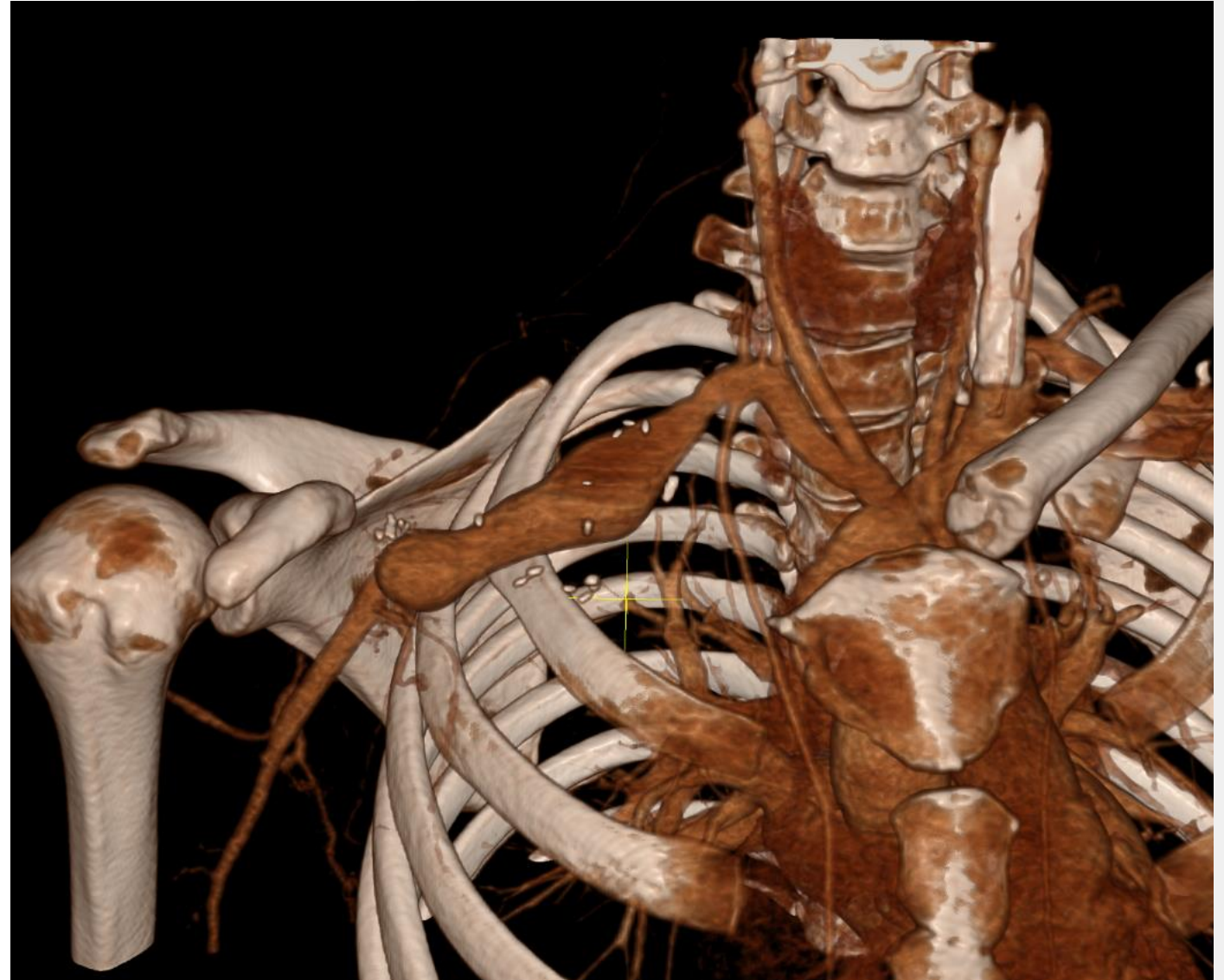


- Casuïstiek
 - 7j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 14j: al 3 x PTA gehad wegens restenose
 - TOD: verwijderen eerste rib
 - Interponaat verwijderen
 - VSM bypass
 - Supra en infraclaviculaire benadering
 - Helaas...

ATOS: behandeling



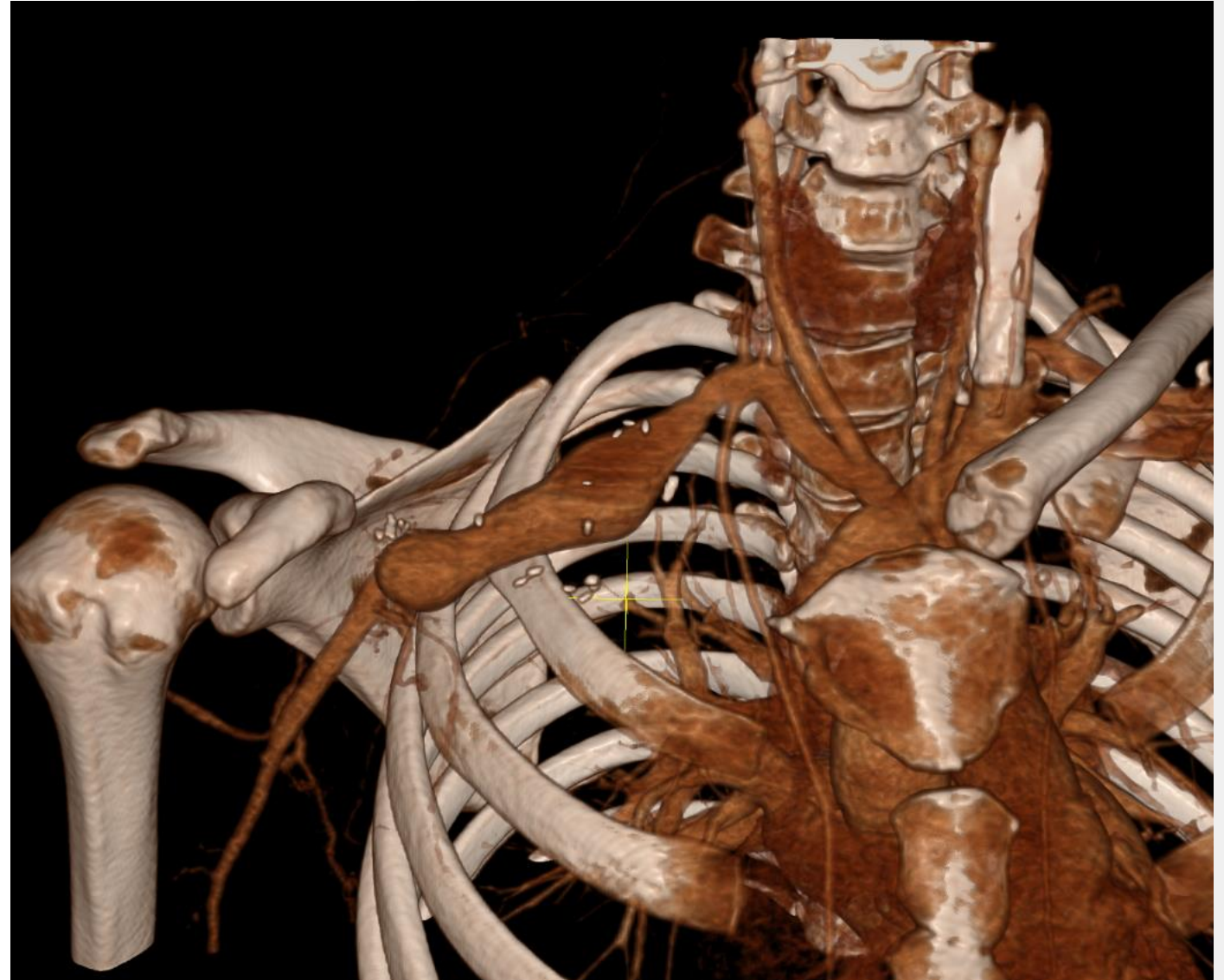
- Casuïstiek
 - 7j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 14j: al 3 x PTA gehad wegens restenose
 - TOD: verwijderen eerste rib
 - Interponaat verwijderen
 - VSM bypass
 - Supra en infraclaviculaire benadering
 - Helaas...



ATOS: behandeling



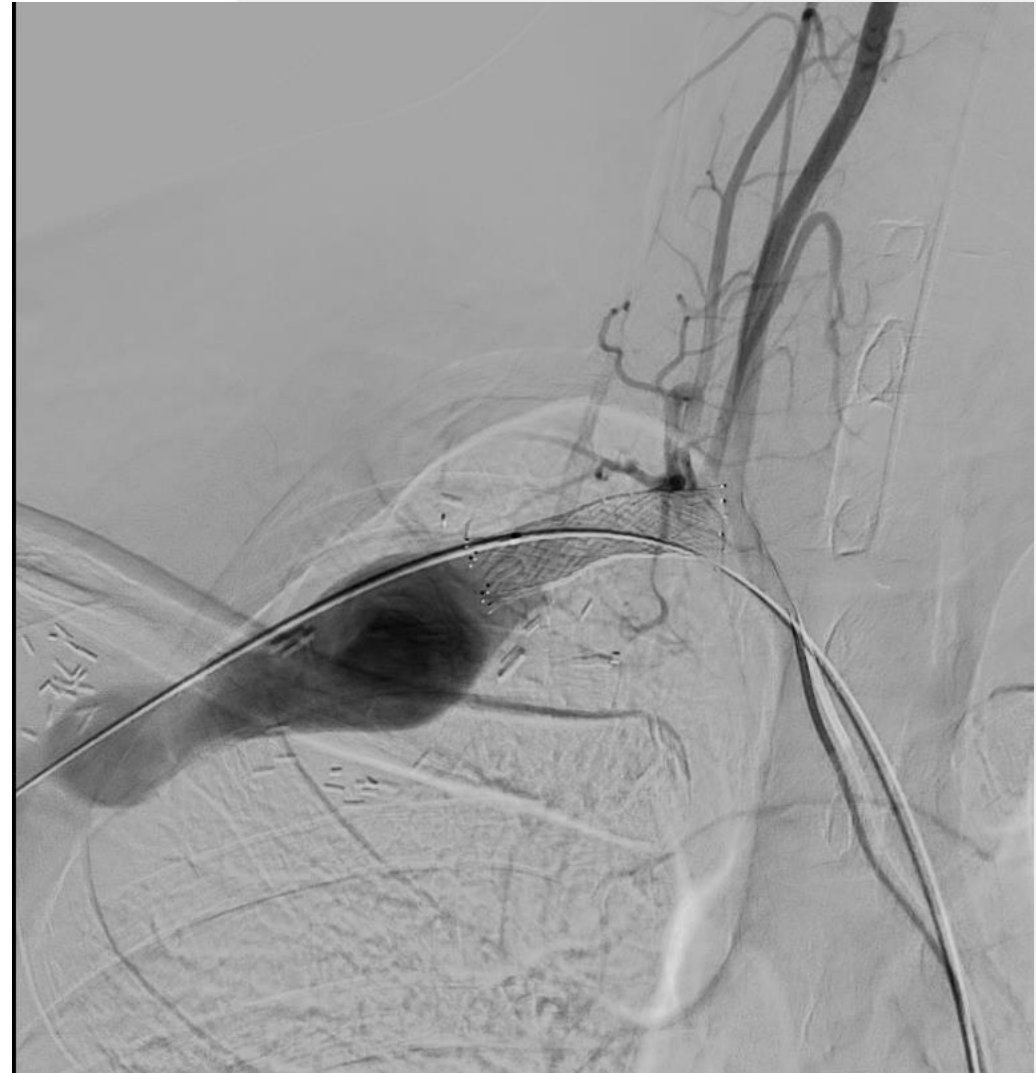
- Casuïstiek
 - 7j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 14j: al 3 x PTA gehad wegens restenose
 - TOD: verwijderen eerste rib
 - Interponaat verwijderen
 - VSM bypass
 - Supra en infraclaviculaire benadering
 - Helaas...
 - REDO en nieuw interponaat



ATOS: behandeling



- Casuïstiek
 - 7j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
 - 14j: al 3 x PTA gehad wegens restenose
 - TOD: verwijderen eerste rib
 - Interponaat verwijderen
 - VSM bypass
 - Supra en infraclaviculaire benadering
 - Helaas...
 - REDO en nieuw interponaat
 - HELAAS

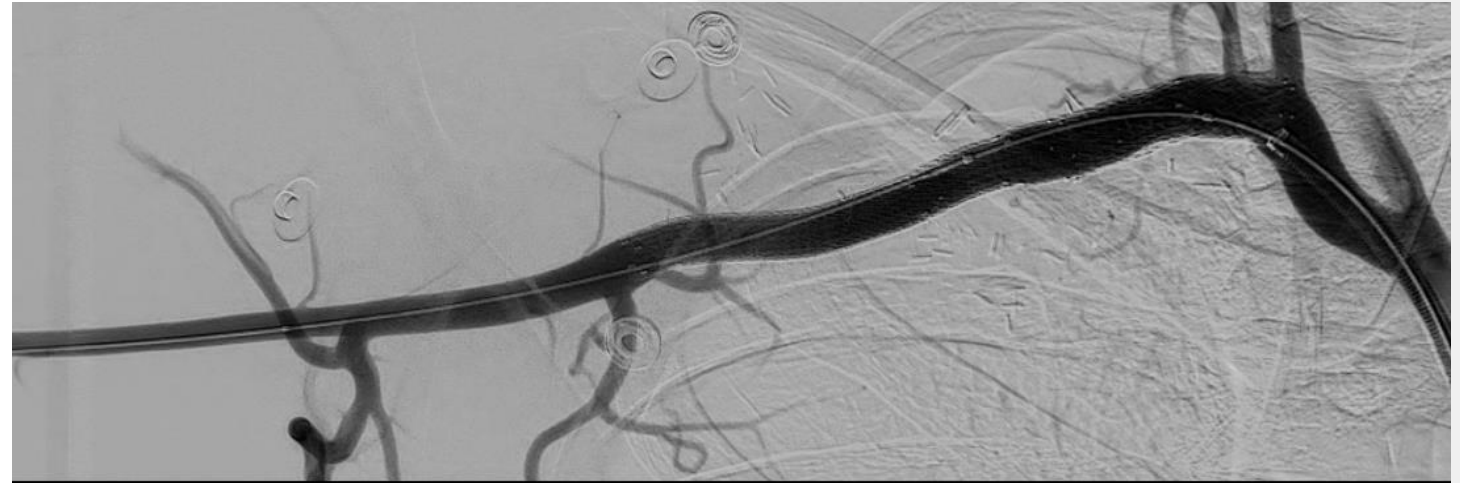


ATOS: behandeling



■ Casuïstiek

- 7j: aneurysma A. Subclavia
 - Interpositie ePTFE graft
 - Geen eerste rib resectie
- 14j: al 3 x PTA gehad wegens restenose
- TOD: verwijderen eerste rib
 - Interponaat verwijderen
 - VSM bypass
 - Supra en infraclaviculaire benadering
- Helaas...
- REDO en nieuw interponaat
- HELAAS



Veneuze TOS



■ Definitie:

5% of cases [1]). The term “vascular TOS” should not be used, as it lumps together two entirely separate problems (VTOS and ATOS) with different causes, anatomy, and treatments.

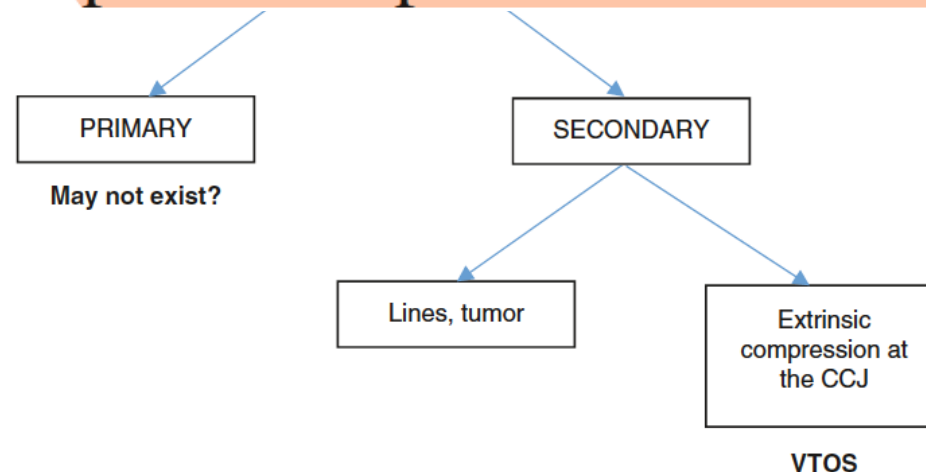
VTOS is described as those who have “signs and symptoms caused by intermittent compression or partial or complete thrombosis of the subclavian vein at the costoclavicular junction [2].” What does this really mean? We feel that

central lines, pacemaker or defibrillator leads). Only problems secondary to the CCJ or retropectoral space are considered VTOS.

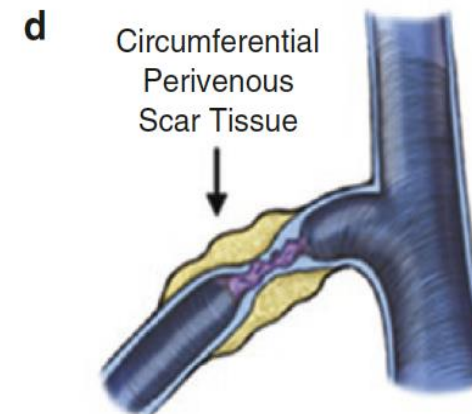
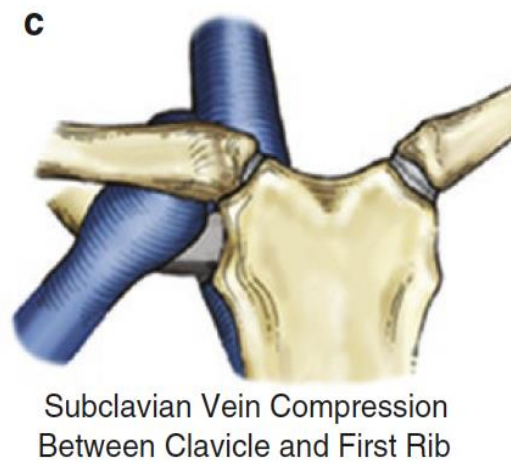
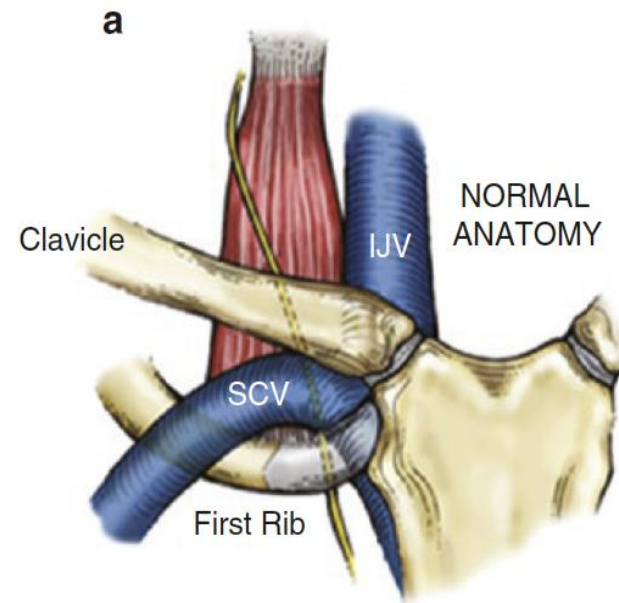
How is true VTOS (pathology secondary to the CCJ) subdivided? In a broad sense, it is divided into thrombosis or intermittent compression (Fig. 54.2). Thrombosis, in turn (according to the SVS reporting standards), is classified as acute (within 14 days), subacute (15 days–3 months), or

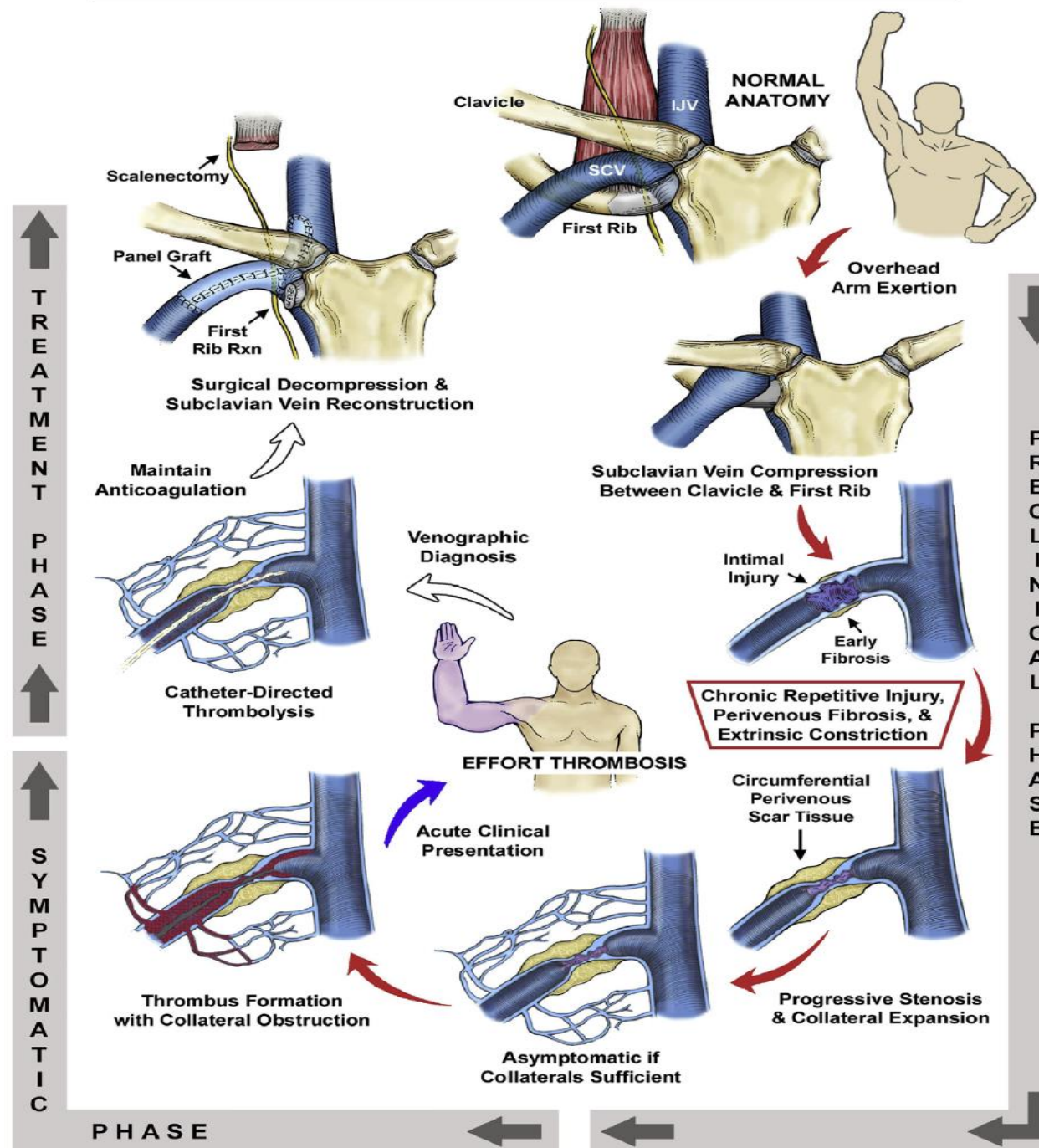
Fig. 54.1 Overall algorithm dividing axillosubclavian vein pathology into primary (no obvious cause) and secondary (obvious underlying physical cause). Secondary problems due to extrinsic compression at the costoclavicular angle (CCJ) represent venous thoracic outlet syndrome (VTOS), and at the retropectoral space, venous pectoralis minor syndrome (not shown)

Only problems secondary to the CCJ or retropectoral space are considered VTOS.

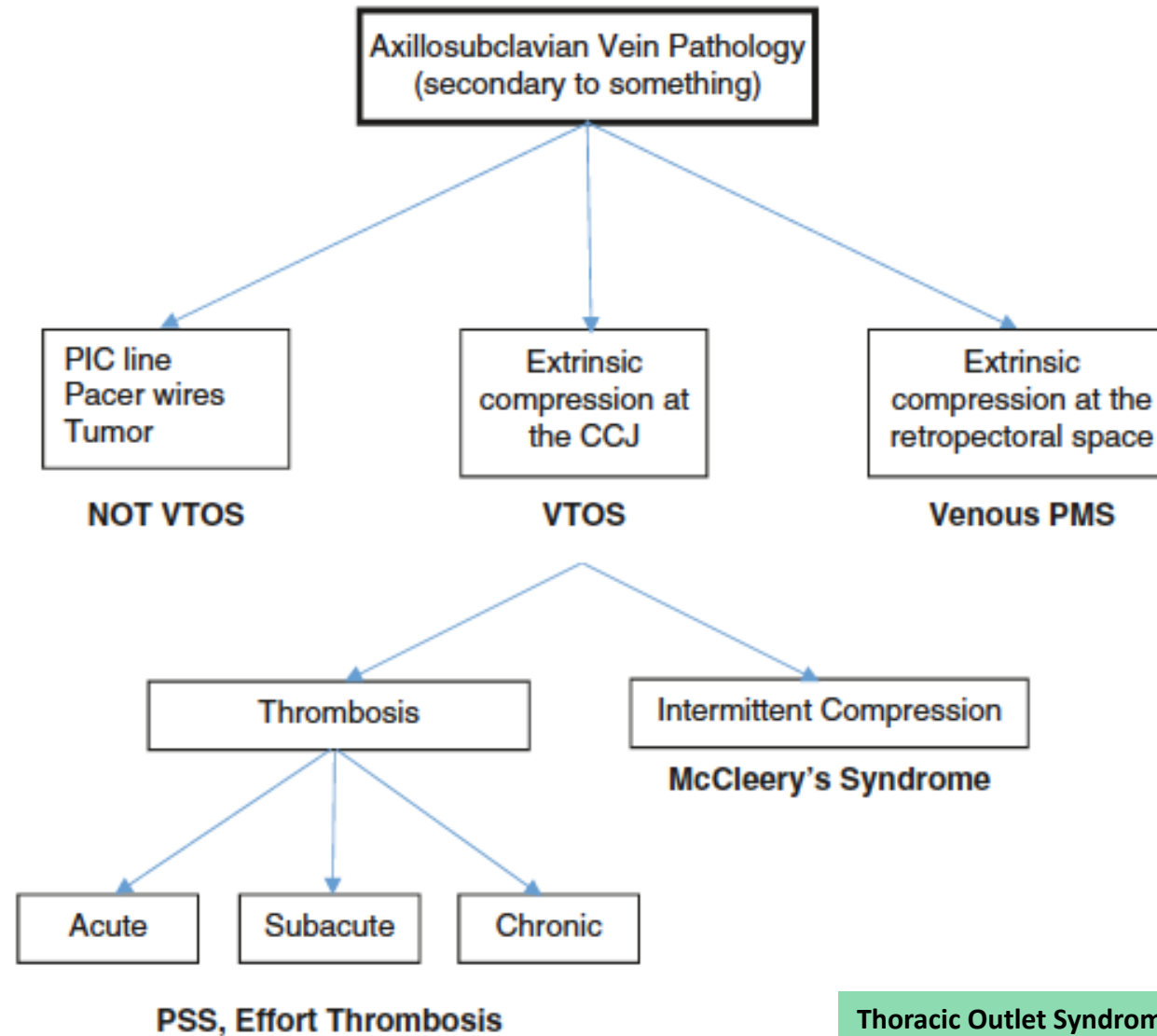


Classificatie VTOS





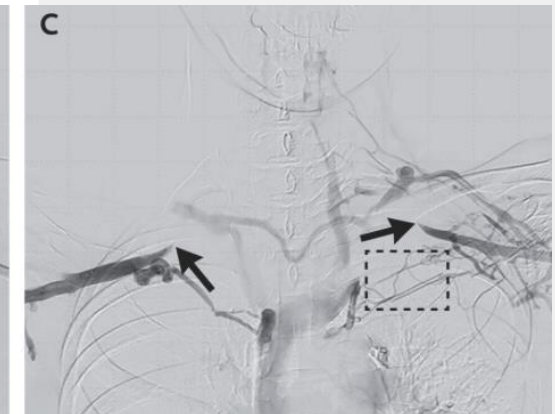
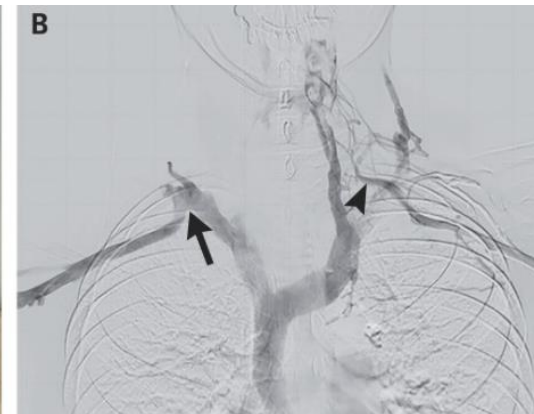
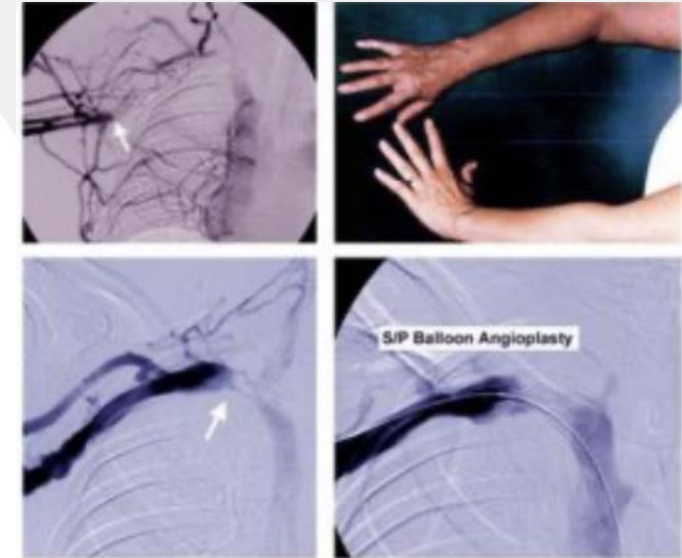
Classificatie VTOS



Veneuze TOS: principes van behandeling



- 3 problemen behandelen:
 - Oorzaak behandelen
 - Costoclaviculair
 - Retropectorale ruimte
 - Schade aan V subclavia behandelen
 - Buigpunt van de arm
 - Rekening mee houden!
- **Verskil in behandeling tussen acute en chronische VTOS**



Acute VTOS/Paget Schroetter Syndrome/UEDVT

- UEDVT approx. 10% van alle DVT
- M:V = 2:1
- 15-35 jaar
- 60-80% repetitieve activiteit van de arm



Acute VTOS: symptomen

- Opgezette venen (100%)
- Gezwollen arm (93%)
- Blauwe verkleuring (77%)
- Pijn, meer pijn bij inspanning (66%)
- Longembolen (incidenteel)

CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis[☆]



Urschel's sign
Increased venous collaterals around the shoulder



Swelling
Bluish
Pain

Acute VTOS: Diagnostiek



- D-dimeren – suboptimaal ^{1,2}
- Duplex – opgelet, 21% vals negatief ^{2, 3}
- **Venogram – gouden standaard** ²
- CTV – Minder duidelijk dan venogram²
- MRV – Duur, tijdsintensief. Niet aanbevolen ²

1. Sartori M et al. D-dimer for the diagnosis of upper extremity deep and superficial venous thrombosis. Thromb Res 2015;135: 673e8

2. Stavros K. Kakkos et al. European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis. pgs 46-48

3. Brownie ER et al. False-negative upper extremity ultrasound in the initial evaluation of patients with suspected subclavian vein thrombosis due to thoracic outlet syndrome (Paget-Schroetter syndrome). Journal of Vascular Surgery: Venous and Lymphatic Disorders. 2020: Volume 8; Number 1;118-126

CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis[☆]

Diagnostiek VTOS: Duplex?



Recommendation 52

For patients with suspected upper extremity deep vein thrombosis, ultrasound is recommended as the initial imaging investigation.

Class	Level	Reference
I	C	Kraaijpoel <i>et al.</i> (2017) ²⁸⁸

3.1.1.3. Imaging modalities. Compression ultrasound is the most commonly used imaging initial test for the diagnosis of UEDVT with use of colour duplex to assess the subclavian vein. In a systematic review of 11 studies that compared ultrasound with venography the pooled sensitivity and specificity for compression ultrasound was 91% and 93%, respectively. These results should be interpreted with caution as the studies had small numbers of patients and had methodological limitations.²⁸⁸

Kraaijpoel N *et al.* The diagnostic management of upper extremity deep vein thrombosis: a review of the literature. *Thromb Res* 2017;156:54e9.

Diagnostiek VTOS: Duplex?

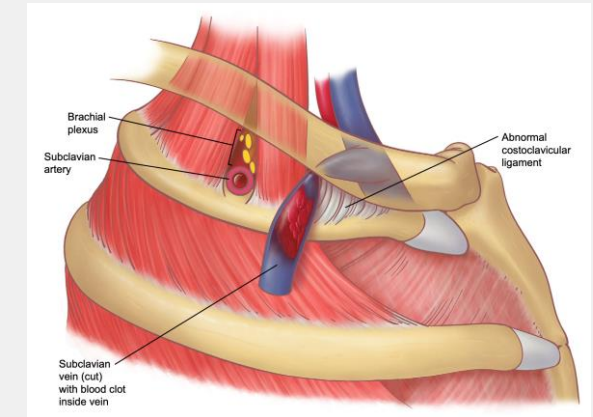


False-negative upper extremity ultrasound in the initial evaluation of patients with suspected subclavian vein thrombosis due to thoracic outlet syndrome (Paget-Schroetter syndrome)

Evan R. Brownie, MD, Ahmmad A. Abuirqeba, BA, J. Westley Ohman, MD, Brian G. Rubin, MD, and Robert W. Thompson, MD, *St. Louis, Mo*

Conclusions: Duplex ultrasound has significant limitations in the initial evaluation of patients with suspected SCV thrombosis, **with false-negative results in 21%** of patients with proven VTOS. This is rarely acknowledged in ultrasound reports, but false-negative ultrasound studies have the potential to delay definitive imaging, thrombolysis, and further treatment for VTOS. Initial false-negative ultrasound results are associated with progressive thrombus extension and a

FN 21%



Brownie ER et al. False-negative upper extremity ultrasound in the initial evaluation of patients with suspected subclavian vein thrombosis due to thoracic outlet syndrome (Paget-Schroetter syndrome). *Journal of Vascular Surgery: Venous and Lymphatic Disorders*. 2020: Volume 8; Number 1;118-126



Acute UEDVT: Guidelines

- 3 guidelines:

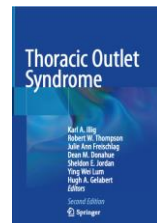
Antithrombotic Therapy for VTE Disease CHEST Guideline and Expert Panel Report

2016

CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis★

2021



Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome

Karl A. Illig, MD,^a Dean Donahue, MD,^b Audra Duncan, MD,^c Julie Freischlag, MD,^d Hugh Gelabert, MD,^e Kaj Johansen, MD,^f Sheldon Jordan, MD,^g Richard Sanders, MD,^h and Robert Thompson, MD,ⁱ Tampa, Fla; Boston, Mass; London, Ontario, Canada; Sacramento and Los Angeles, Calif; Seattle, Wash; Aurora, Colo; and St. Louis, Mo

2016

UEDVT: Guidelines



CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis[☆]

Recommendation 53		
For patients with primary upper extremity deep vein thrombosis, anticoagulation therapy for <u>three months</u> is recommended.		
Class	Level	References
I	C	Montiel <i>et al.</i> (2017), ²⁹² Schastlivtsev <i>et al.</i> (2019) ²⁹³

Recommendation 54		
<u>In most patients</u> with symptomatic primary upper extremity deep vein thrombosis, <u>early thrombus removal is not recommended.</u>		
Class	Level	Reference
III	C	Guzzo <i>et al.</i> (2010) ²⁹⁹

Recommendation 55		
In selected young and active patients with upper extremity <u>deep vein thrombosis with severe symptoms</u> , thrombolysis may be considered within the first two weeks.		
Class	Level	References
IIb	C	Bosma <i>et al.</i> (2011), ³⁰³ Illig & Doyle (2010) ³⁰⁵

Recommendation 56		
For patients with upper extremity deep vein thrombosis treated by early thrombus removal, <u>first rib resection may</u> be considered if there is clear evidence of venous thoracic outlet syndrome.		
Class	Level	Reference
IIb	C	Lugo <i>et al.</i> (2015) ³⁰¹



UEDVT: Guidelines

Aanbevelingen op basis van

- Retrospectieve observationele studies
- Gebrek aan data of trombolyse het post-trombotisch syndroom verminderd
- Enkele publicaties met bloeding als complicatie van trombolyse
- Trombolyse is complexer

Antithrombotic Therapy for VTE Disease CHEST Guideline and Expert Panel Report

27. In patients with acute upper extremity DVT (UEDVT) that involves the axillary or more proximal veins, we suggest anticoagulant therapy alone over thrombolysis (Grade 2C).

28. In patients with UEDVT who undergo thrombolysis, we recommend the same intensity and duration of anticoagulant therapy as in patients

UEDVT: Guidelines



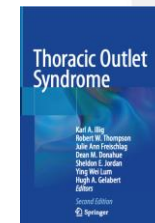
- Invasieve therapie als uitzondering bij
 - Jonge, actieve patienten
 - Ernstige symptomen
 - UEDVT veroorzaakt door compressie aan de CCJ (VTOS)

HOE WEET JE DAT?

Antithrombotic Therapy for VTE Disease
CHEST Guideline and Expert Panel Report

CLINICAL PRACTICE GUIDELINE DOCUMENT

European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis [☆]



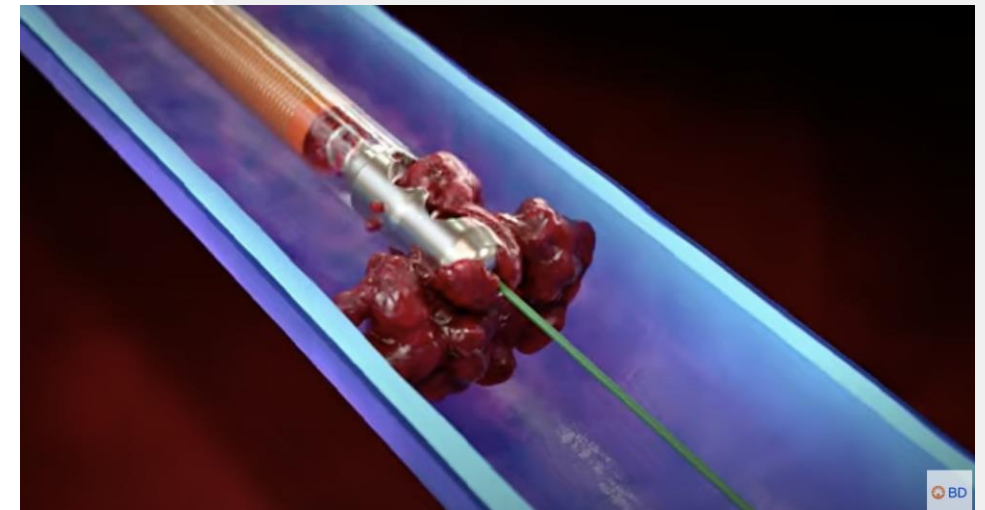
Reporting standards of the Society for Vascular Surgery for thoracic outlet syndrome

Karl A. Illig, MD,^a Dean Donahue, MD,^b Audra Duncan, MD,^c Julie Freischlag, MD,^d Hugh Gelabert, MD,^e Kaj Johansen, MD,^f Sheldon Jordan, MD,^g Richard Sanders, MD,^h and Robert Thompson, MD,ⁱ Tampa, Fla; Boston, Mass; London, Ontario, Canada; Sacramento and Los Angeles, Calif; Seattle, Wash; Aurora, Colo; and St. Louis, Mo

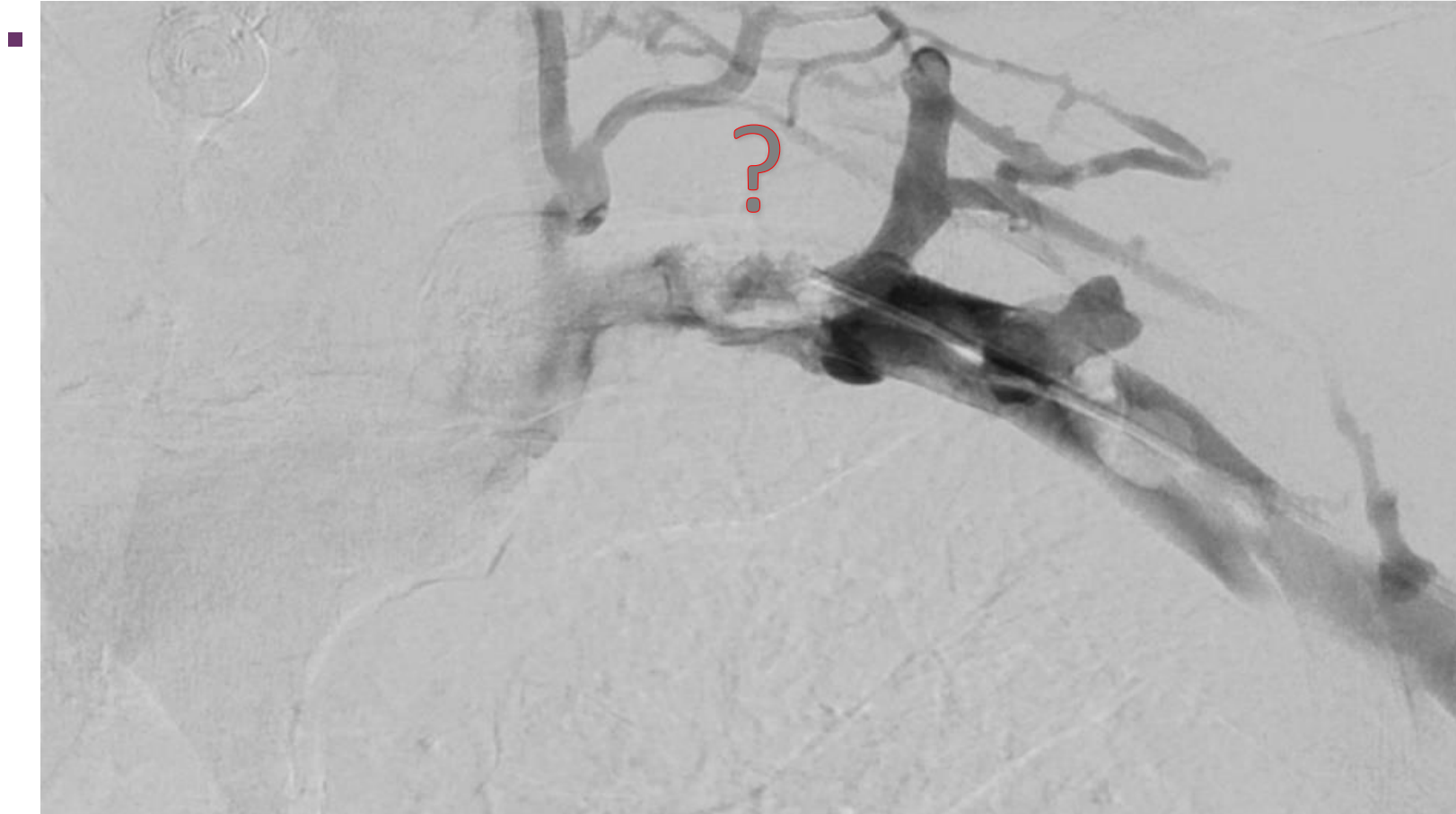
Hoe weet je of er compressie is van de V. Subclavia aan de CCJ? / VTOS ??



- Zonder de trombus te verwijderen, kan je de CCJ niet evalueren!
 - Alleen na trombolyse/trombectomie
 - Na anticoagulatie, als de vene recanaliseert...
 - Bij chronische occlusie.... Too bad?

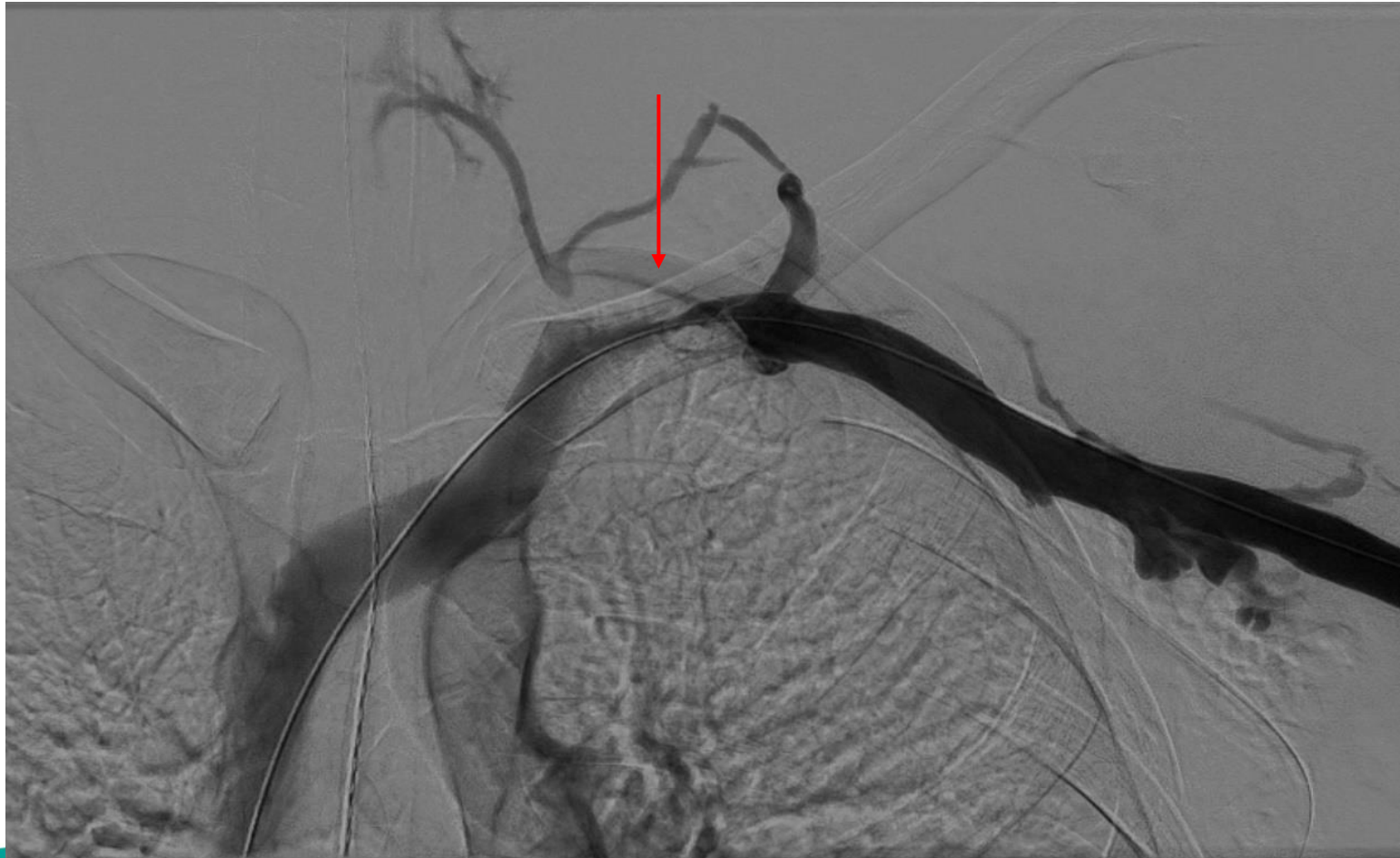


Hoe weet je of er compressie is van de V. Subclavia aan de CCJ? / VTOS ??



M 24 yrs
UEDVT L for 5 days

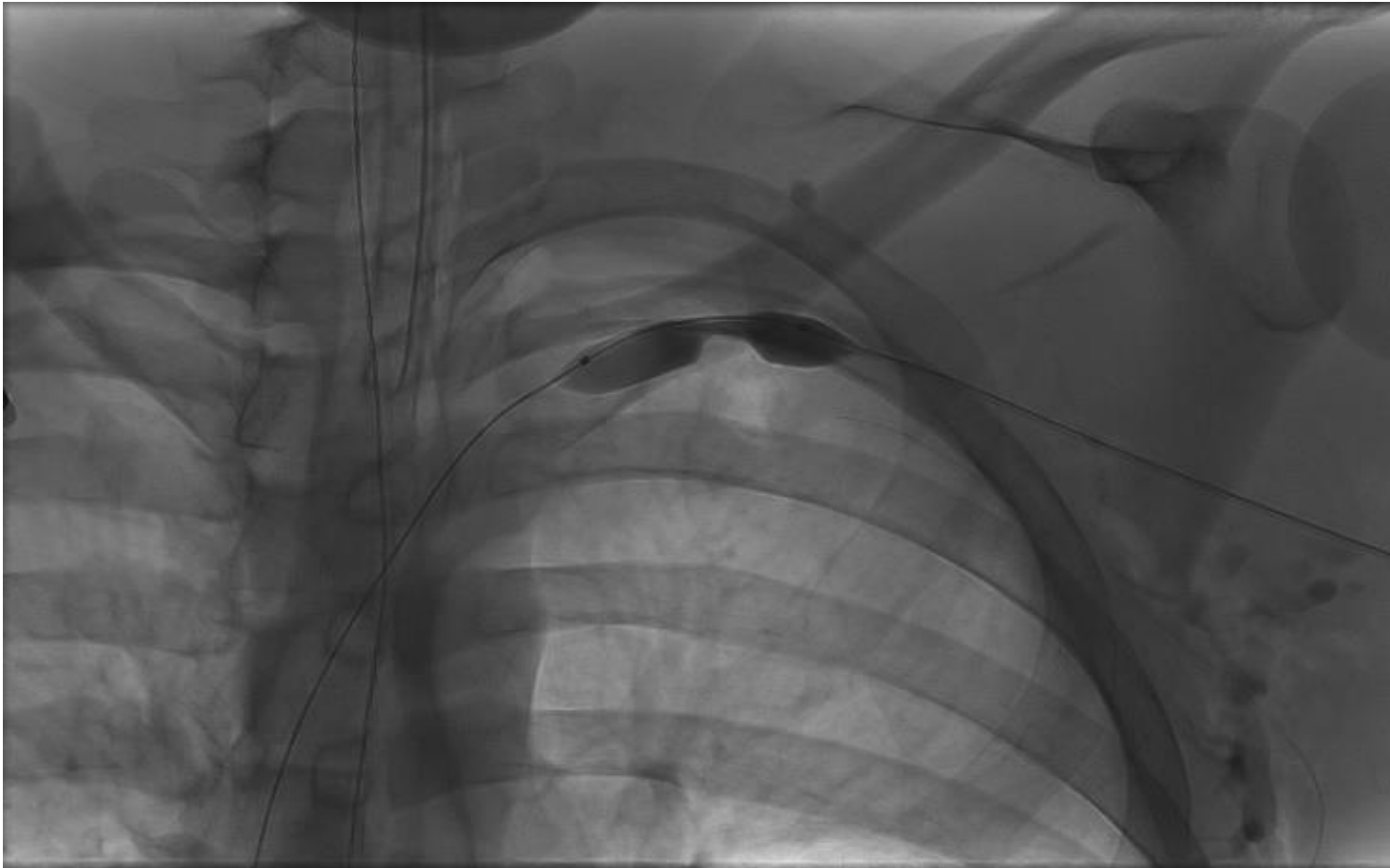
Hoe weet je of er compressie is van de V. Subclavia aan de CCJ? / VTOS ??



M 24 yrs
After Thrombolysis,
TOD + venolysis

VTOS: diagnostiek en therapie

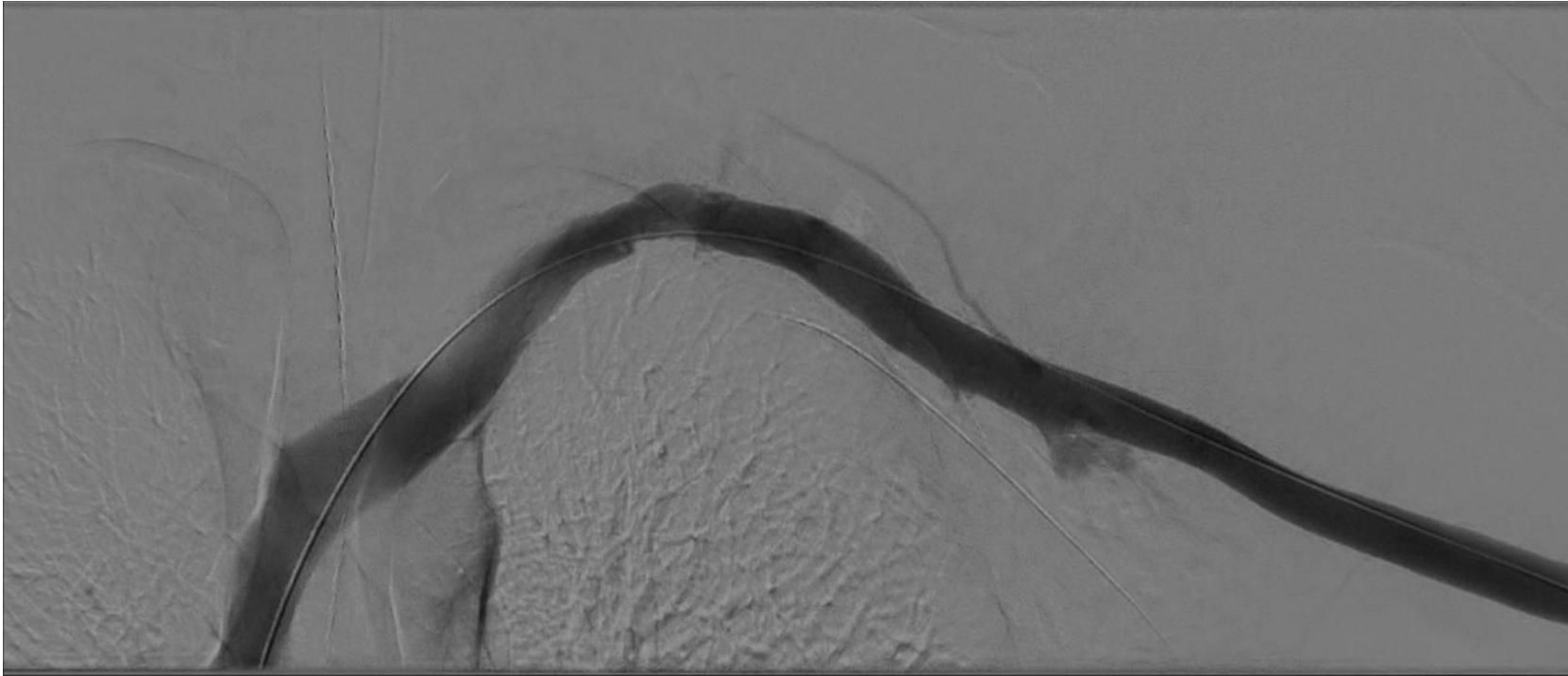
- Behandeling van PSS



- Example of tapering during test-PTA after thoracic outlet decompression surgery in 'patient x'.

VTOS: diagnostiek en therapie

- Behandeling van PSS

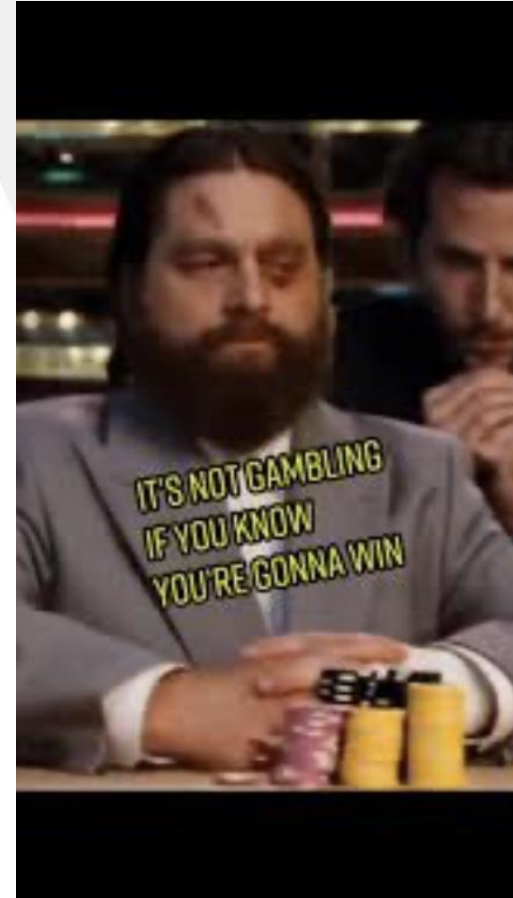


- Situation after same admission thrombolysis, TOD with venolysis and PTA in 'patient x'.

Wie selecteren?



- Elke patient met (primaire) trombosearm = VTOS tot tegendeel bewezen is!
 - Geen gok
 - Axillo-subclavia DVT
 - Leeftijd... <50
 - Geen hematologische/oncologische VG
 - Effort trombose
 - Symptomen < 21 dagen
 - Actieve patient
 - ~~Erge klachten...~~

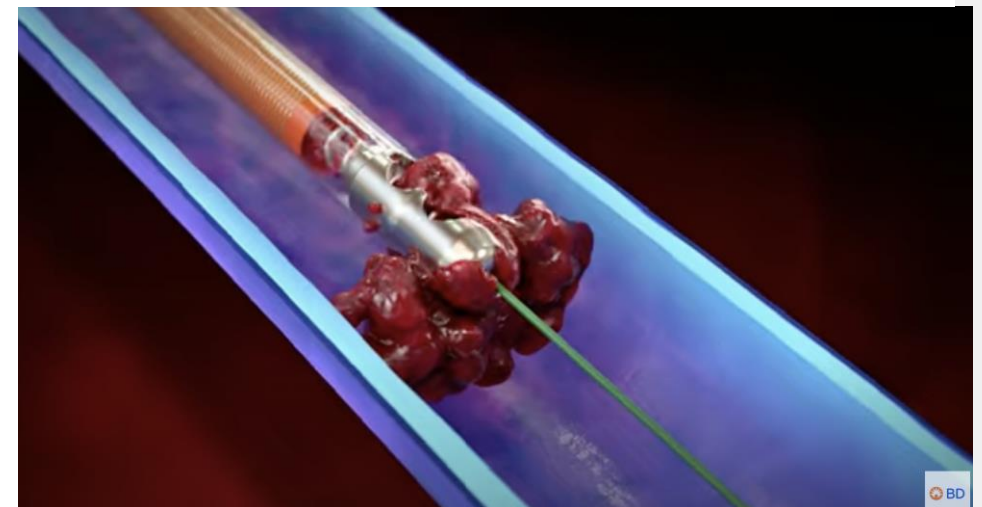
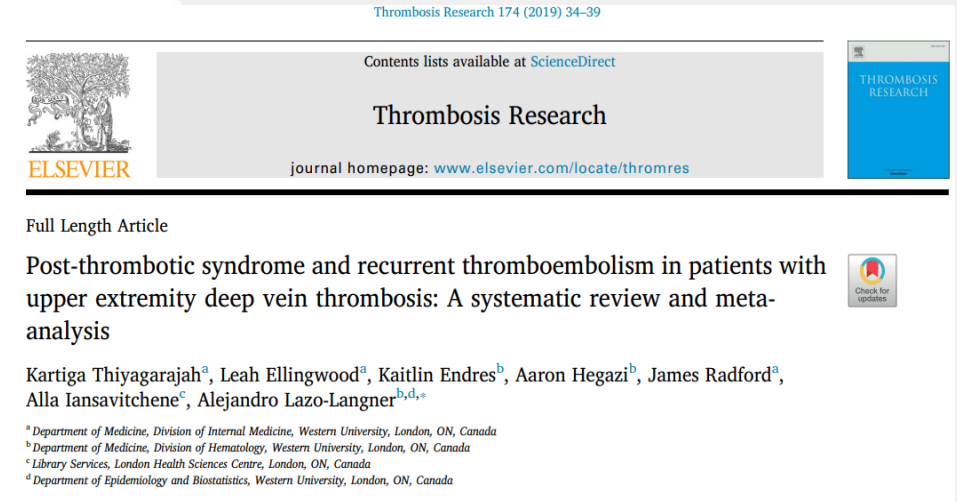


Complicaties Trombolyse



- Er is een verschil in complicaties tussen arteriele en veneuze trombolyse
 - Geen access site complicaties
- Patient die intra-arteriele trombolyse krijgen zijn oud en hebben comorbiditeiten
 - Risico op bloeden neemt toe
- Trombectomie devices hebben veel minder bleedingscomplicaties

fluoroscopic guidance. In a recent meta-analysis including 3 550 patients in 60 studies, major bleeding occurred in patients with UEDVT in 5% after anticoagulation alone and 3.8% after thrombolysis and/or surgery.²⁸⁴ Thrombolysis is most



Complicaties Trombolyse



SYSTEMATIC REVIEW

Management of Paget-Schroetter Syndrome: a Systematic Review and Meta-Analysis

Frank Hoexum ^a, Max Hoebink ^b, Hans M.E. Coveliers ^b, Willem Wisselink ^a, Vincent Jongkind ^{a,†}, Kak Khee Yeung ^{a,*,†}

^a Department of Vascular Surgery, Amsterdam Cardiovascular Sciences, Amsterdam University Medical Centres, Amsterdam, the Netherlands

^b General District Hospital, Aalst, Belgium

Supplementary Table S8. Systematic review on the management of Paget-Schroetter syndrome. Of the 60 included reports, 10 reports provided data on complications of catheter-based therapies.

1st author	ref	P	C	complications
Pesser	8	40	1	Venous injury during PTA (conservative)
Zehnder	12	18	1	Contrast related acute kidney injury
kärkäinen	23	22	1	intimal tear requiring surgical reconstruction and stent
Trenor	28	19	0	no complications of catheter based therapy
Bosma	35	31	1	pulmonary embolism**
doyle	44	26	1	stroke like episode
Gelabert	45	30	0	no complications of catheter based therapy
Coletta	54	6	1	flebitis after venography
Yilmaz	58	24	1	pulmonary embolism**
Machleder	66	28	4	2x allergic reaction to streptokinase, 1x flebitis, 1x hematoma
Totals		244	11	

Table legend: P= number of procedures, C= number of complications, **= possible overlapping data

Complicaties of anticoagulatie



- **Kans post-trombotisch syndroom (PTS)**
 - Is hoog! (20,3%)
- **Kans op recidief trombose**
 - Is niet laag (6,4%) (bias??)
- **Majeure bloeding in 5%**

Thrombosis Research 174 (2019) 34–39

Contents lists available at ScienceDirect

Thrombosis Research

journal homepage: www.elsevier.com/locate/thromres

ELSEVIER

Full Length Article

Post-thrombotic syndrome and recurrent thromboembolism in patients with upper extremity deep vein thrombosis: A systematic review and meta-analysis

Kartiga Thiyagarajah^a, Leah Ellingwood^a, Kaitlin Endres^b, Aaron Hegazi^b, James Radford^a, Alla Iansavitchene^c, Alejandro Lazo-Langner^{b,d,*}

^a Department of Medicine, Division of Internal Medicine, Western University, London, ON, Canada
^b Department of Medicine, Division of Hematology, Western University, London, ON, Canada
^c Library Services, London Health Sciences Centre, London, ON, Canada
^d Department of Epidemiology and Biostatistics, Western University, London, ON, Canada

Check for updates

Table 1

Overall proportion of post-thrombotic syndrome and recurrent thrombosis in patients with upper extremity deep vein thrombosis, using a random effects model^a.

	Post-thrombotic syndrome			Recurrent thrombosis		
	Patients, <i>n</i>	Pooled proportion (%)	(95% CI)	Patients, <i>n</i>	Pooled proportion (%)	(95% CI)
All UEDVT	944	19.4	(11.3–27.6)	2552	7.5	(4.1–10.9)
Primary	656	20.3	(11.0–29.5)	1011	6.4	(3.7–9.1)
Secondary	187	14.0	(0.0–30.0)	335	15.9	(0.6–31.2)

Outcomes chirurgie



SYSTEMATIC REVIEW

Management of Paget-Schroetter Syndrome: a Systematic Review and Meta-Analysis

Frank Hoexum ^a, Max Hoebink ^a, Hans M.E. Coveliers ^b, Willem Wisselink ^a, Vincent Jongkind ^{a,†}, Kak Khee Yeung ^{a,*,†}

^a Department of Vascular Surgery, Amsterdam Cardiovascular Sciences, Amsterdam University Medical Centres, Amsterdam, the Netherlands

^b General District Hospital, Aalst, Belgium

Table 1. Meta-analysis of observational evidence on the management of Paget-Schroetter syndrome using a generalised linear mixed model. The functional outcome was specified as being symptom free at last follow up. The functional outcome improved with increasingly invasive therapy, from 0.54 in anticoagulation (AC) alone to 0.96 in patients treated with catheter directed thrombolysis (CDT) followed by first rib resection (FRR)

Treatment	Reports	Patients – n	Symptom free patients – n	Weighted pooled proportion (95% CI)	I ² – %
AC	10	180	80	0.54 (0.17 – 0.88)	58
CDT + AC	13	150	108	0.71 (0.44 – 0.88)	1
AC + FRR	14	171	115	0.80 (0.56 – 0.93)	0
CDT + FRR	31	1 284	1 199	0.96 (0.91 – 0.98)	25

CI = confidence interval; I² = statistic for heterogeneity.

6. Veneuze remodeling



- Trombus veroorzaakt een inflammatoire reactie van de vaatwand
- Chronic vein inflammation (CVI) is geassocieerd met verdikking, fibrotische veranderingen en vermindering compliantie van de vaatwand.
- CVI veroorzaakt valve incompetentie
- CVI is een van de belangrijkste oorzaken van het post trombotisch syndroom (PTS)

Vein wall remodeling after deep vein thrombosis involves matrix metalloproteinases and late fibrosis in a mouse model

Kristopher B. Deatrick, BA, Jonathan L. Eliason, MD, Erin M. Lynch, BA, Andrea J. Moore, BS, Nicholas A. Dewyer, Manu R. Varma, BS, Charles G. Pearce, BA, Gilbert R. Upchurch, Jr, MD, Thomas W. Wakefield, MD, and Peter K. Henke, MD, *Ann Arbor, Mich*

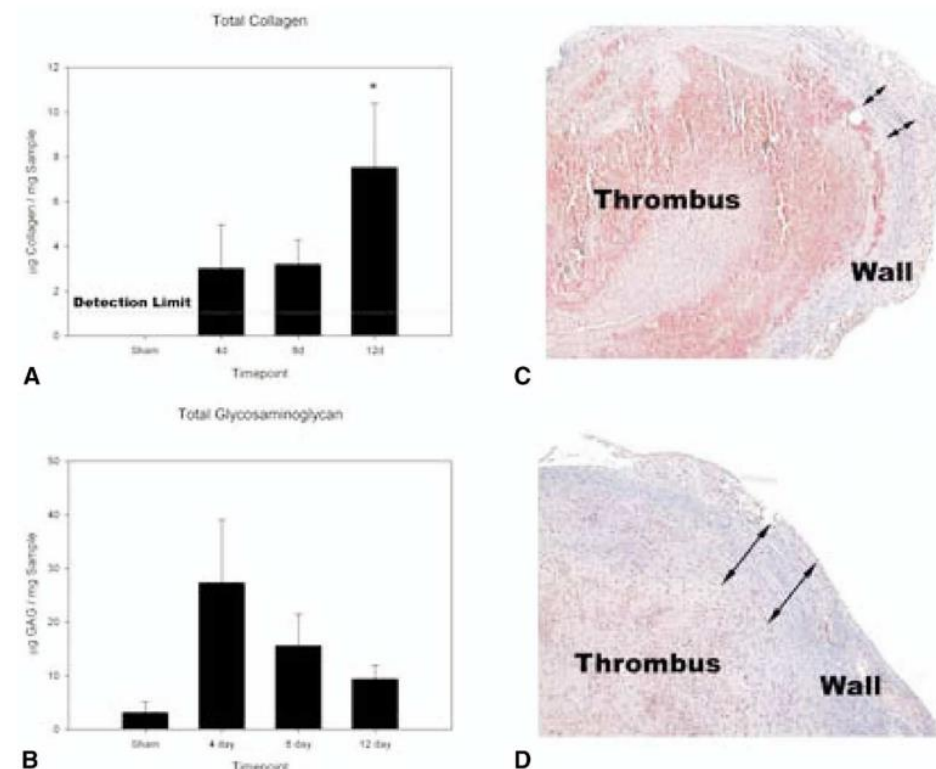
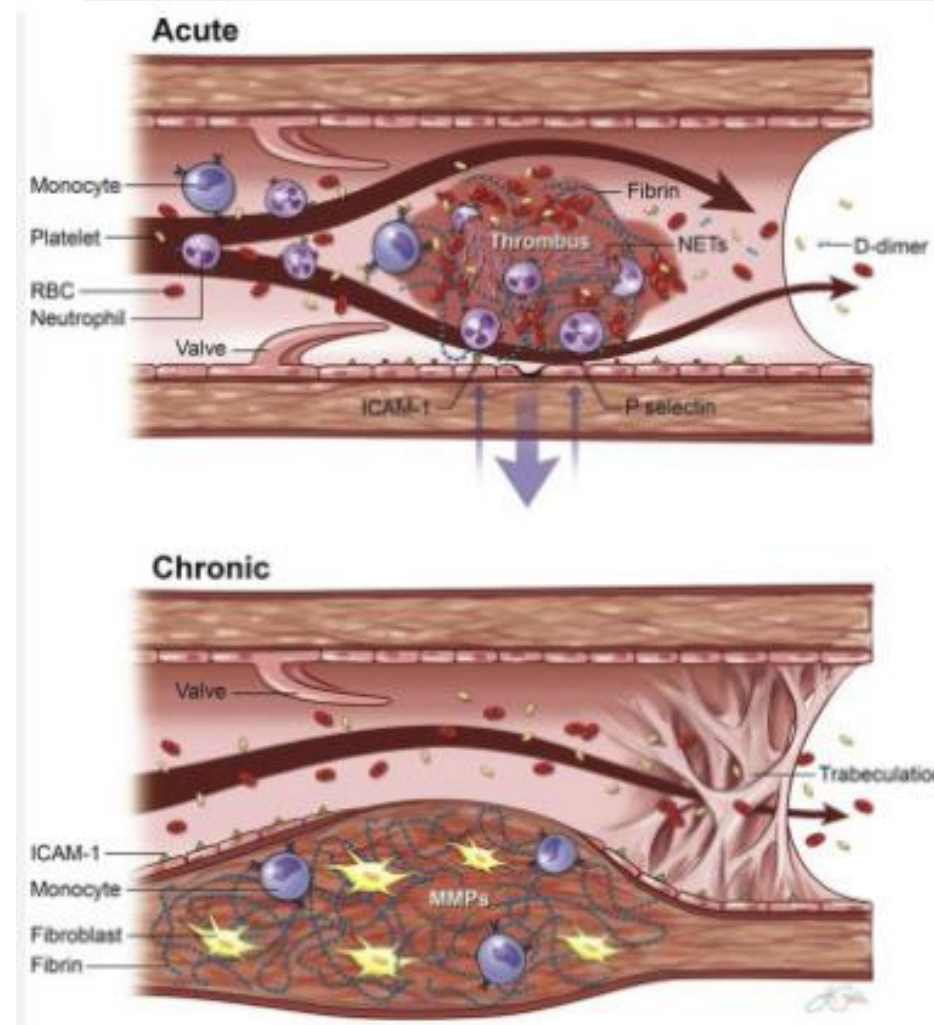


Fig 2. Total collagen and glycosaminoglycan (GAG) content (data are means $\pm$ SEM). **a**, Total collagen content increased significantly after thrombus formation, far above the minimal amount detectable at baseline ($n = 5$, $*P = .015$). **b**, Total GAGs, however, increased acutely but decreased during the period of thrombus resolution (day 4 to day 12). As the duration of the thrombus exposure increased from (c) 4 to (d) 12 days, Brillmeyer's trichrome stain for collagen in the vessel wall demonstrated an increased thickness (arrows) of the vein wall ($n = 5$) ($\times 125$).

6. Veneuze remodeling

- **Trombolyse neemt trombus weg**
 - Minder kans op CVI
 - Minder kans op PTS
- **De acute VTOS patient**
 - Is jong en actief
 - Sneller aan het werk
 - De verloren Qaly's ikv PTS zijn niet te overzien
 - Anticagulantia is moeilijk bij fertiele jonge vrouwen



6. Veneuze remodeling



Same Admission Hybrid Treatment of Primary Upper Extremity Deep Venous Thrombosis with Thrombolysis, Transaxillary Thoracic Outlet Decompression, and Immediate Endovascular Evaluation

Niels Pesser,¹ Aron Bode,¹ Jens Goeteyn,¹ Joris Hendriks,² Bart F.L. van Nuenen,³ Marc R.H.M. van Sambeek,^{1,4} and Joep A.W. Teijink,^{1,5} Eindhoven, The Netherlands



Catharina Hospital (2017-2023)

Chronic VTOS: 89

Acute VTOS / PSS: 23

McCleery: 14

Surgical management of post-thrombotic syndrome in chronic venous thoracic outlet syndrome

Niels Pesser, BSc,^a Aron Bode, MD, PhD,^a Jens Goeteyn, MD,^a Joris Hendriks, MD,^b Bart F. L. van Nuenen, MD, PhD,^c Karl A. Illig, MD,^d Marc R. H. M. van Sambeek, MD, PhD,^{a,e} and Joep A. W. Teijink, MD, PhD,^{a,f} Eindhoven and Maastricht, The Netherlands; and Orangeburg, SC

6. Veneuze remodeling



Same Admission Hybrid Treatment of Primary Upper Extremity Deep Venous Thrombosis with Thrombolysis, Transaxillary Thoracic Outlet Decompression, and Immediate Endovascular Evaluation

Niels Pesser,¹ Aron Bode,¹ Jens Goeteyn,¹ Joris Hendriks,² Bart F.L. van Nuenen,³ Marc R.H.M. van Sambeek,^{1,4} and Joep A.W. Teijink,^{1,5} Eindhoven, The Netherlands

improvement in function of the arm in all these patients at 38.9 months (range, 20–58). All (10/10) these patients were able to return to work and sport without limitations. Moreover, the mean TOS disability scale was 0.6 and the mean DASH score was 4.2 suggesting minor disabilities of the arm, shoulder, or hand. Quality of life measured with the adapted VEINES-SYM and VEINES-QOL resulted in a median VEINES-SYM score of 55.23 (IQR, 12.13) and VEINES-QOL score of 55.29 (IQR, 15.42).

Table II. Surgical data

Surgical data	<i>n</i> = 10 (100%)
Mean delay to presentation in our clinic (days)	7.2 (1–12)
Successful wire passage	10 (100)
Intraoperative PTA performed	10 (100)
Re-PTA after initial TOD + PTA	3 (30)
Mean time to Re-PTA (days)	32.3 (11–49)
Complications	
Brachial plexus injury	0 (0)
Superficial infection	0 (0)
Postoperative bleeding	2 (20)
Pneumothorax	0 (0)
Scapula alata	0 (0)
Mean operative time (min)	96.1 (58–160)
Mean ASA score	2 (1–3)
Overall length of stay including thrombolysis (days)	6.4 (2–15)
Length of stay after TOD surgery (days)	3.2 (1–12)
Mean follow-up time (months)	34.4 (6–58)

ASA, American Society of Anesthesiologists.

6. Veneuze remodeling

Complications	5 (13.8)
Brachial plexus injury	0 (0)
Horner syndrome (due to hematoma)	1 (3)
Superficial infection	0 (0)
Postoperative bleeding	3 (8)
Vein rupture (during PTA; n = 33)	1 (3)
Pneumothorax	0 (0)
Scapula alata	0 (0)
Phrenic nerve injury	1 (3)
Mean operative time, minutes (range)	148 (76-244)
Mean ASA score	1.77 (1-3)
Mean time to discharge, days (range)	1.9 (1-6)
Follow-up	
Recurrent PTS symptoms requiring venography	8 (22)
Swelling	7 (88)
Discoloration	2 (25)
Visible collateralization	3 (38)
Pain during exercise	4 (50)
Effort-induced complaints	2 (25)
Severe limitations in daily activities (work/sports)	5 (63)
Mean interval to recurrence, days (range)	111 (31-318)
ASA, American Society of Anesthesiologists; PTA, percutaneous transluminal angioplasty; PTS, post-thrombotic syndrome; SCV, subclavian vein; TA-TOD, transaxillary thoracic outlet decompression.	

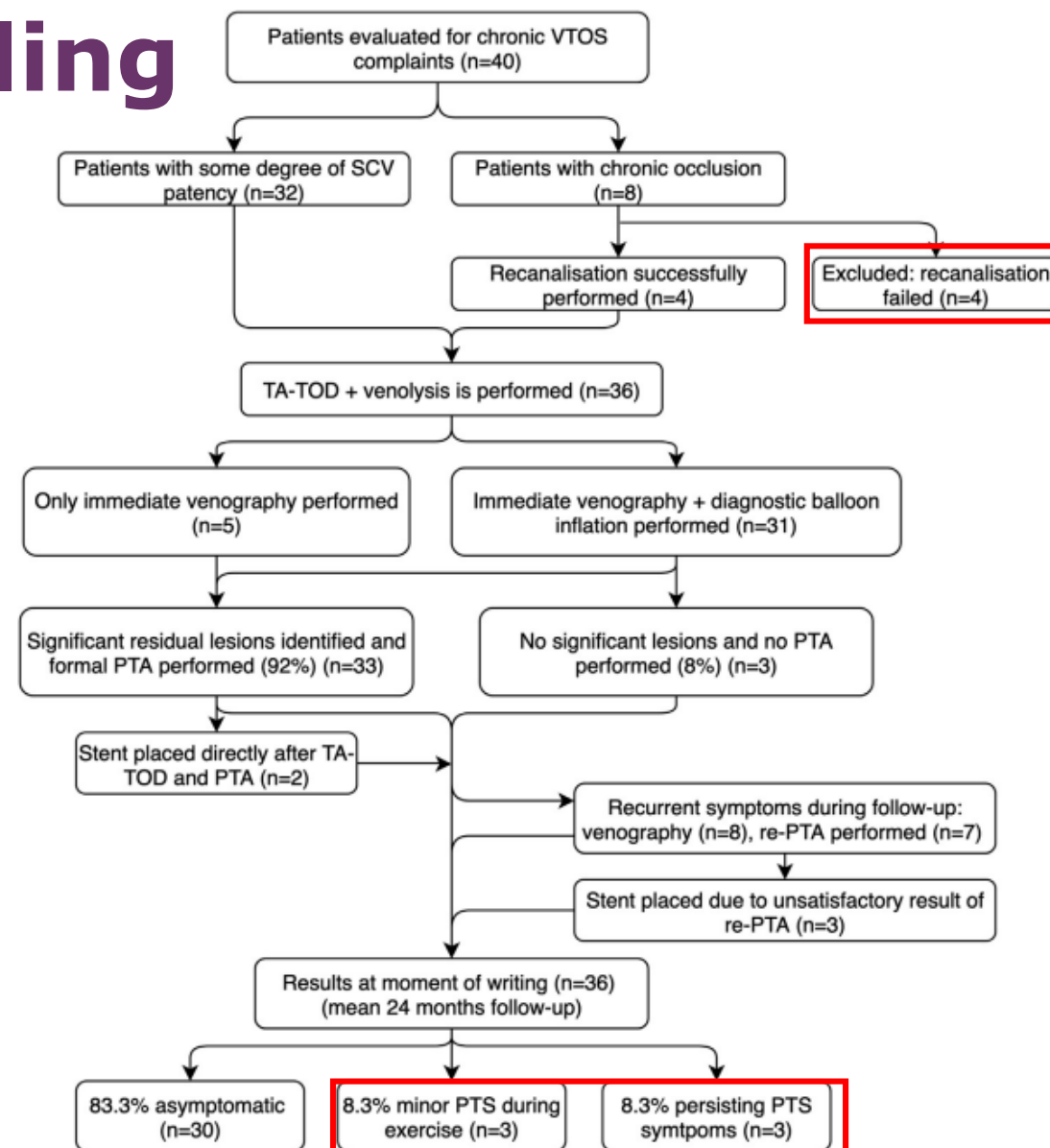


Fig 3. Flowchart of included patients with chronic venous thoracic outlet syndrome (VTOS) patients. PTA, percutaneous transluminal angioplasty; PTS, post-thrombotic syndrome; SCV, subclavian vein; TA-TOD, transaxillary thoracic outlet decompression.

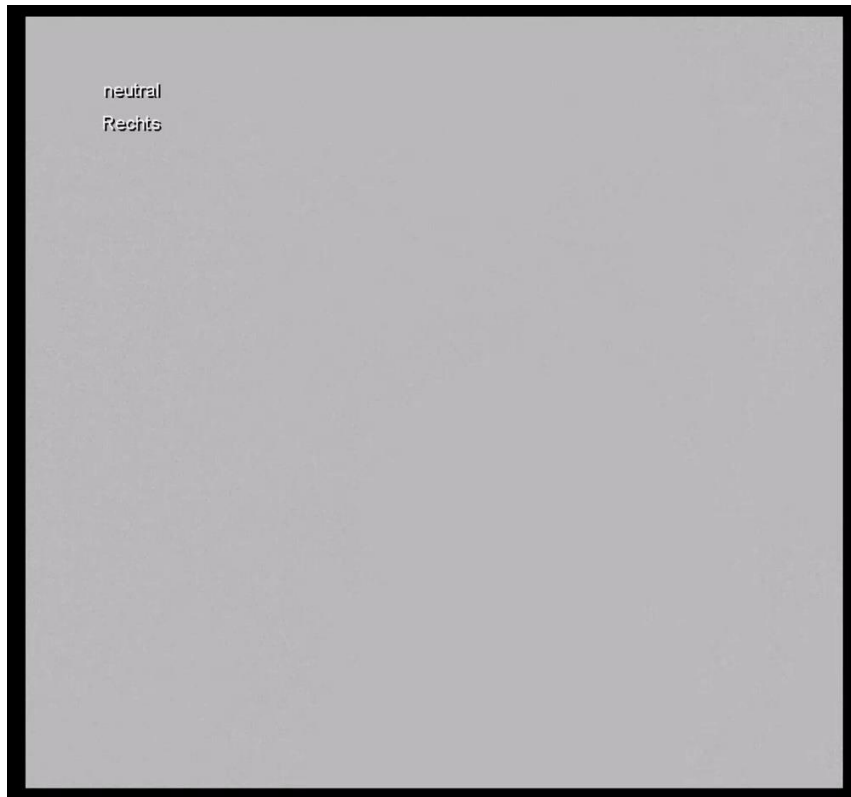
Chronische VTOS



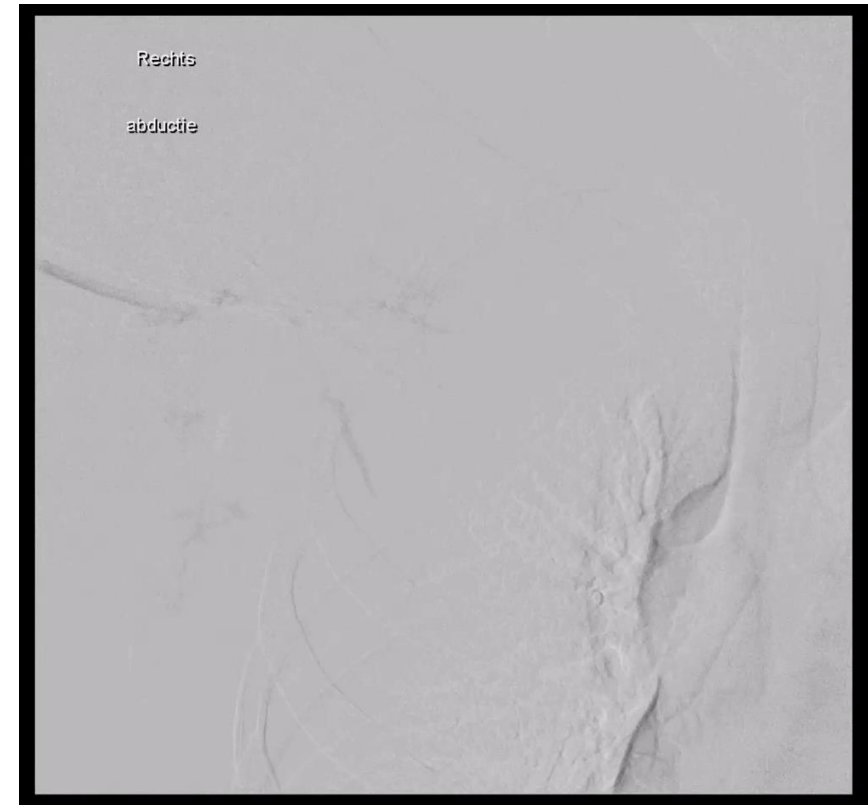
Chronische VTOS met PTS



Flebogram neutraal



Flebogram abductie



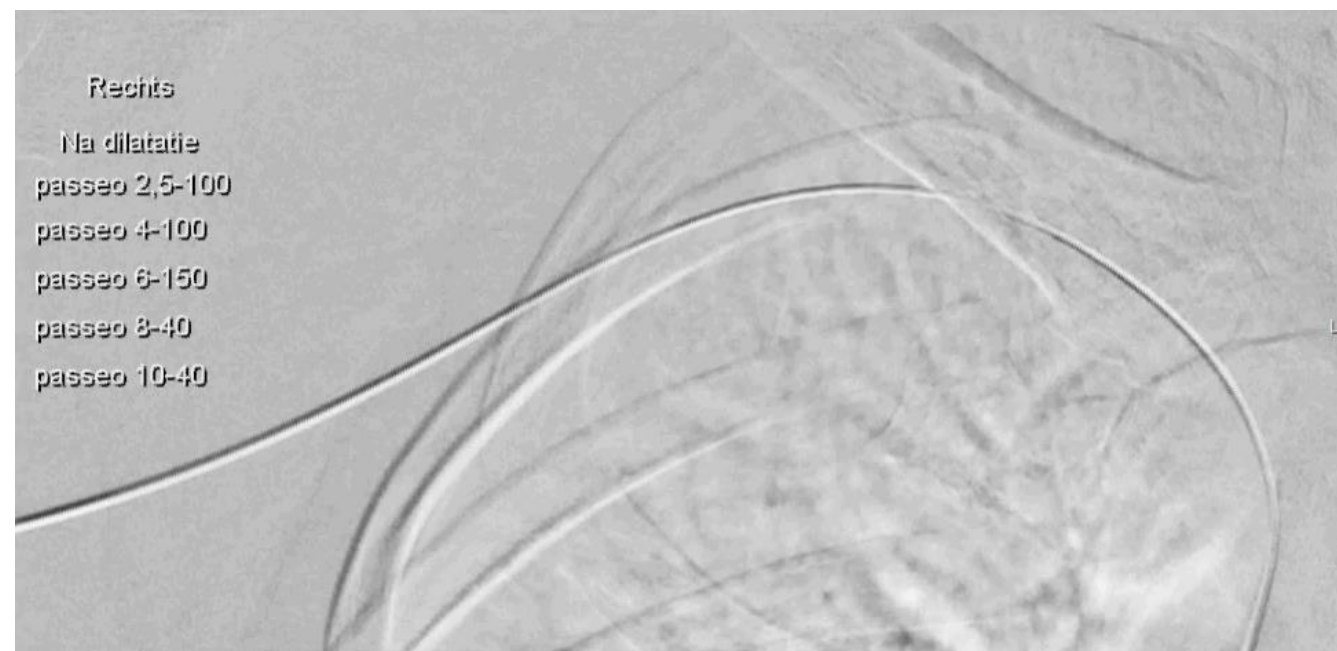
Thoracic outlet decompressie + PTA



Na TOD



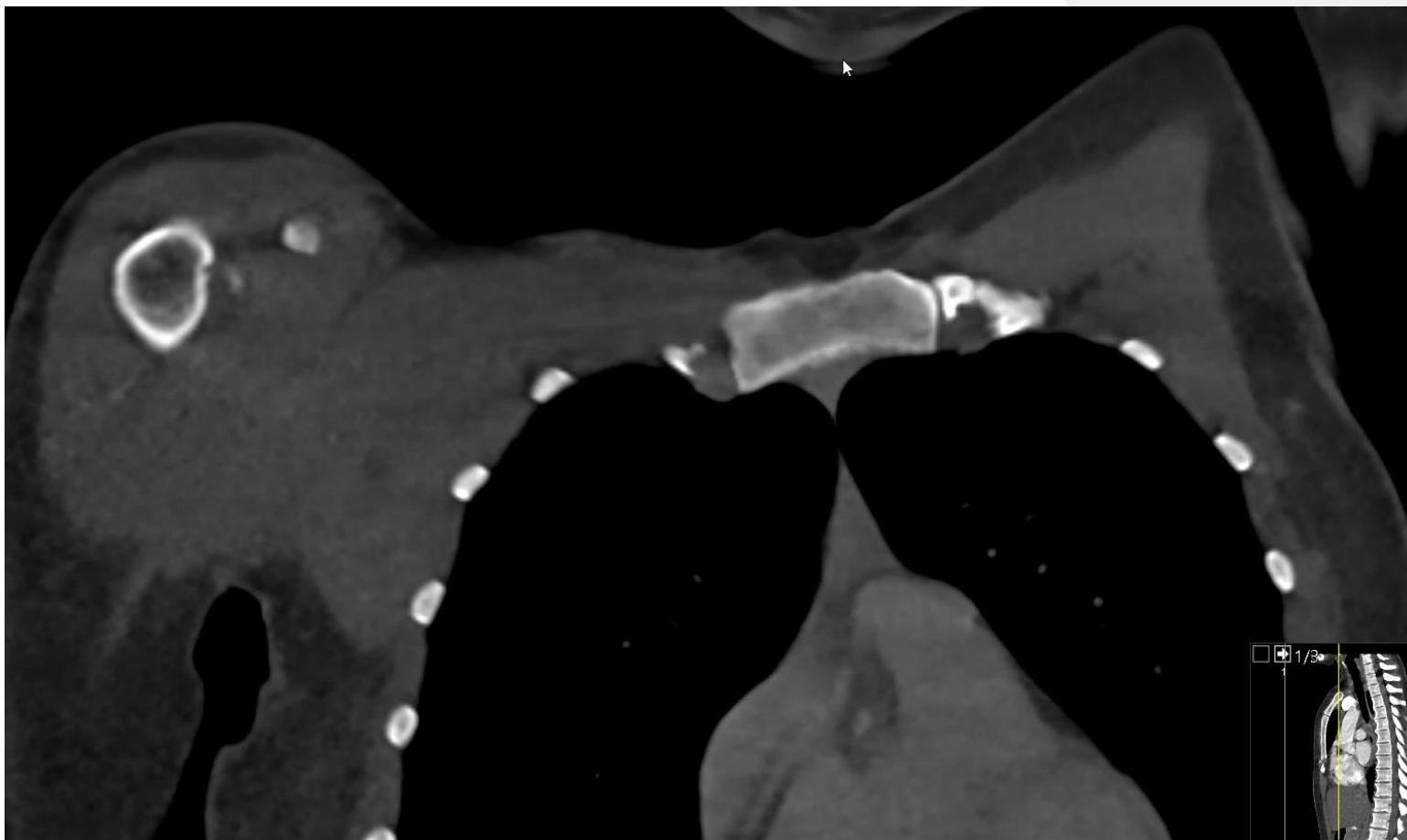
Na PTA

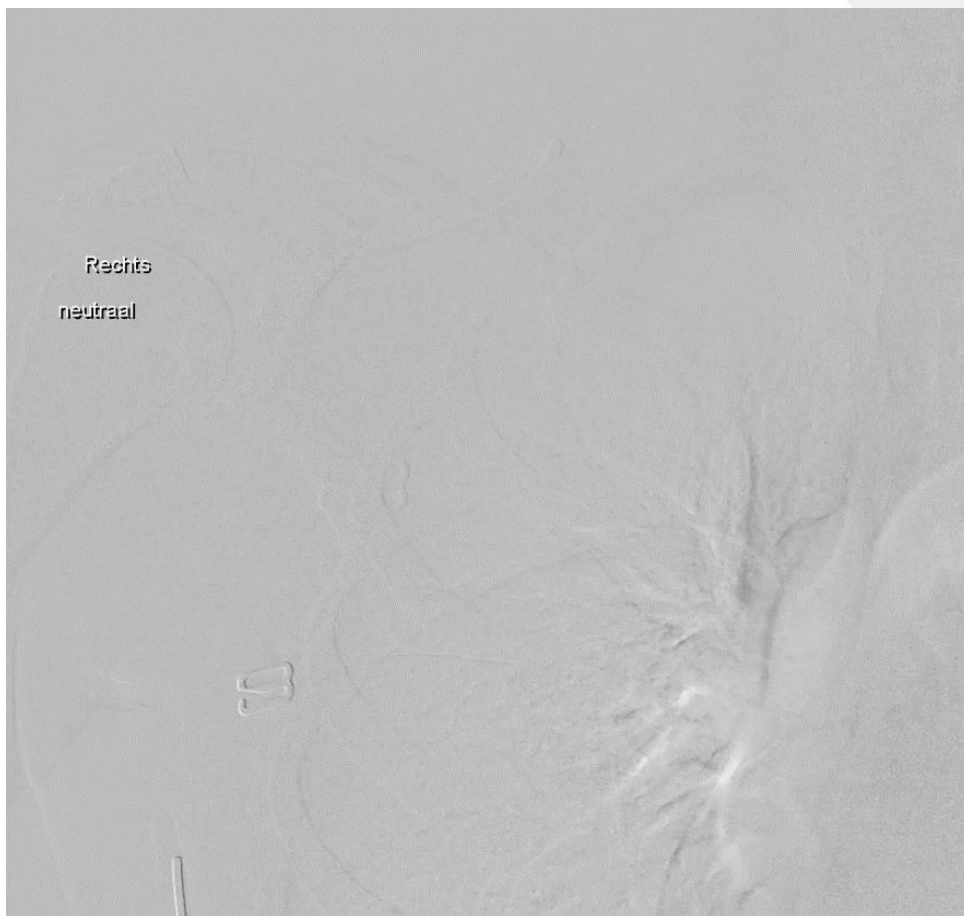




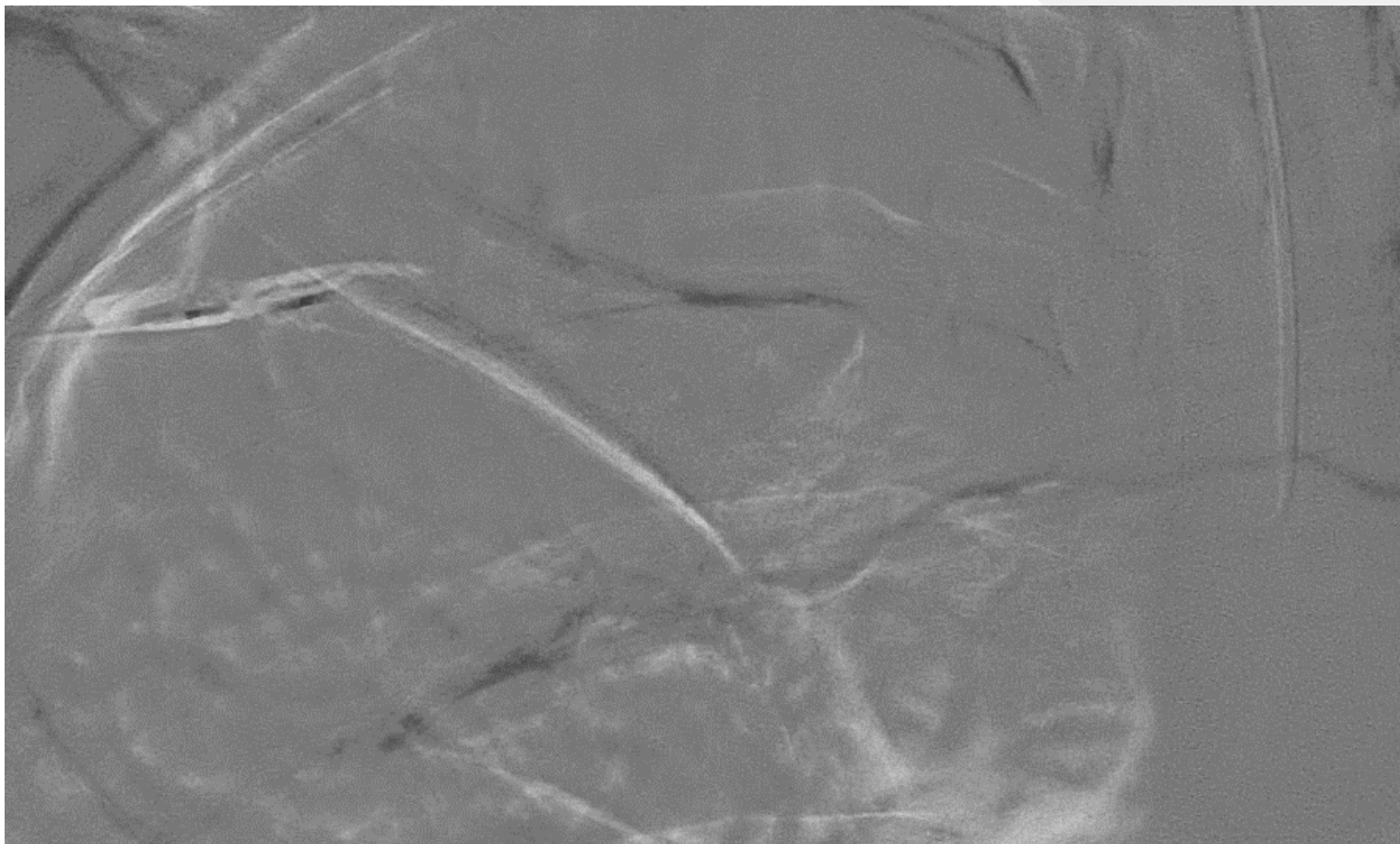
- UEDVT 14-12-2024
- In december 2024 fors gezwollen arm en stuwend gevoel, trombose-arm doorgemaakt. Heeft antistolling en compressietherapie gehad.
- Vervolgens verwijzing naar TOS-centrum. Momenteel geen klachten meer, sport ook veel minder, gebruikt de arm minder. Gebruikt nog wel antistolling, draagt ook compressiekous; dagelijks.

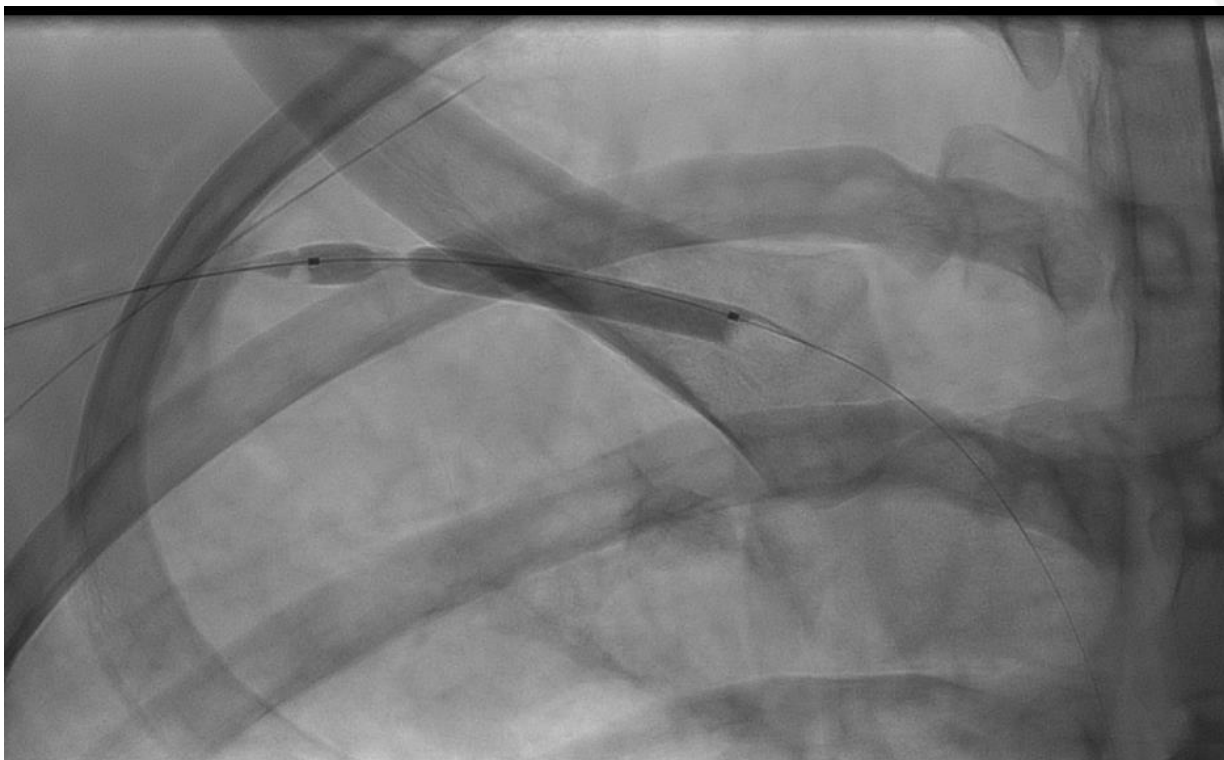


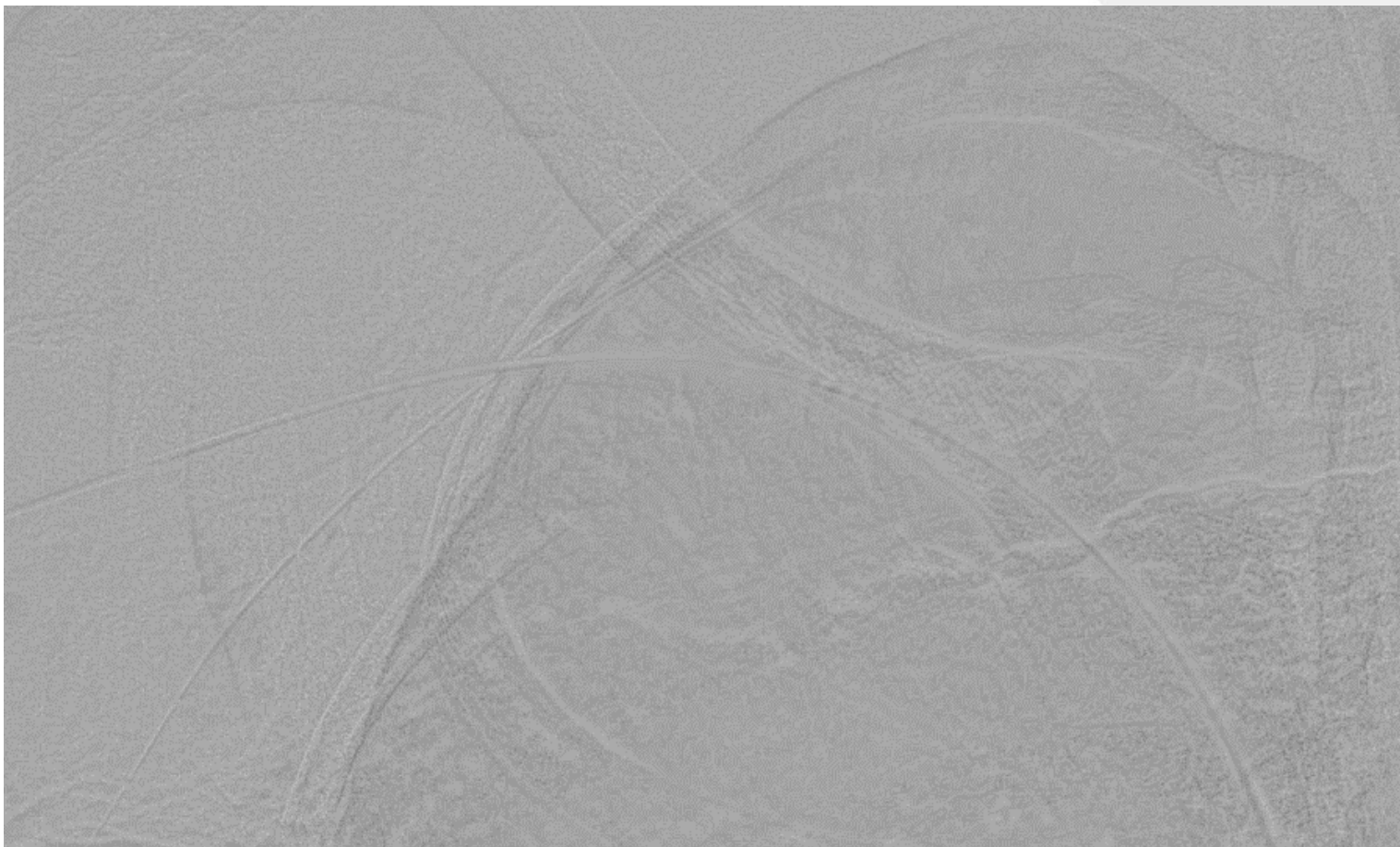


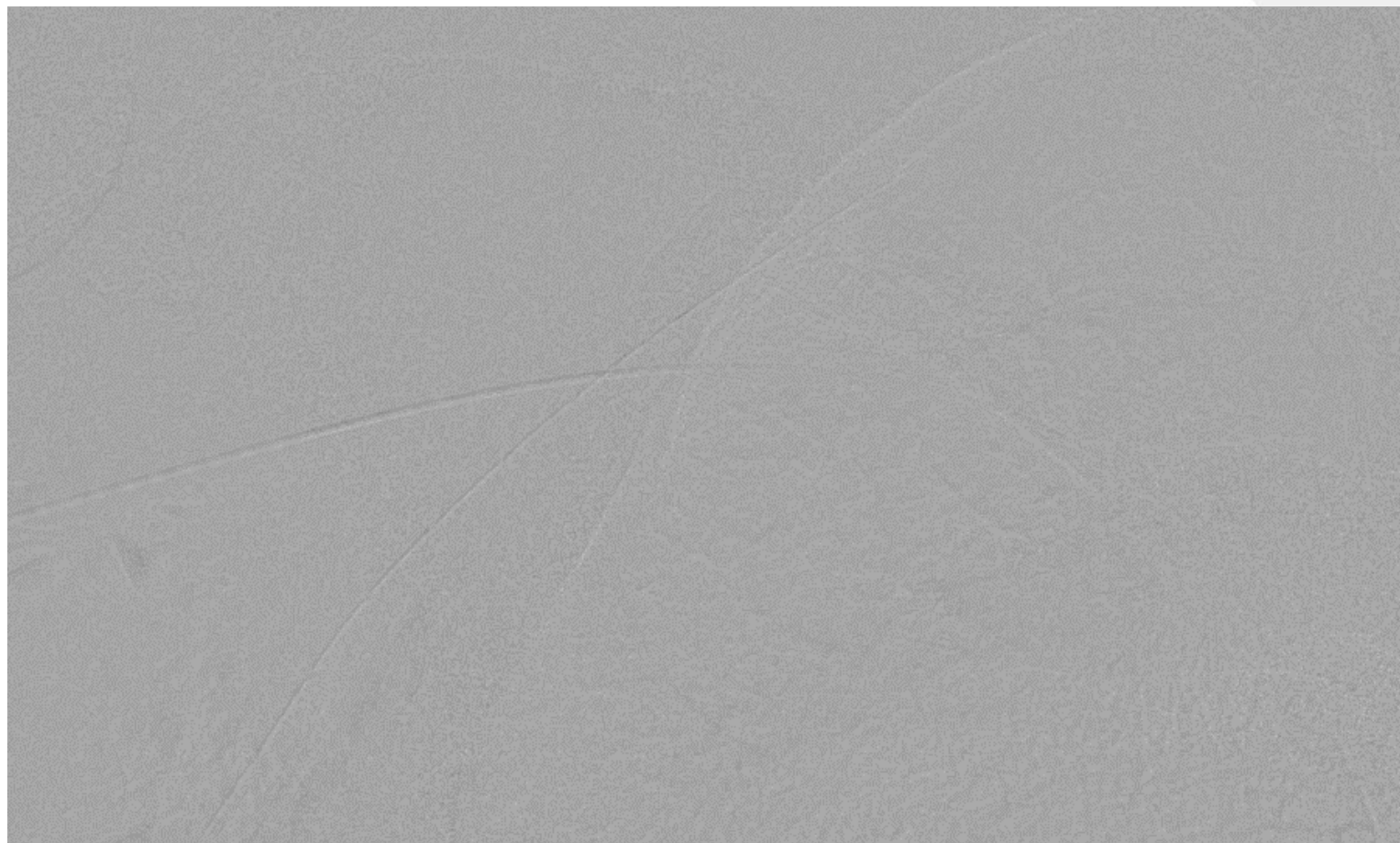












Surgical management of post-thrombotic syndrome in chronic venous thoracic outlet syndrome



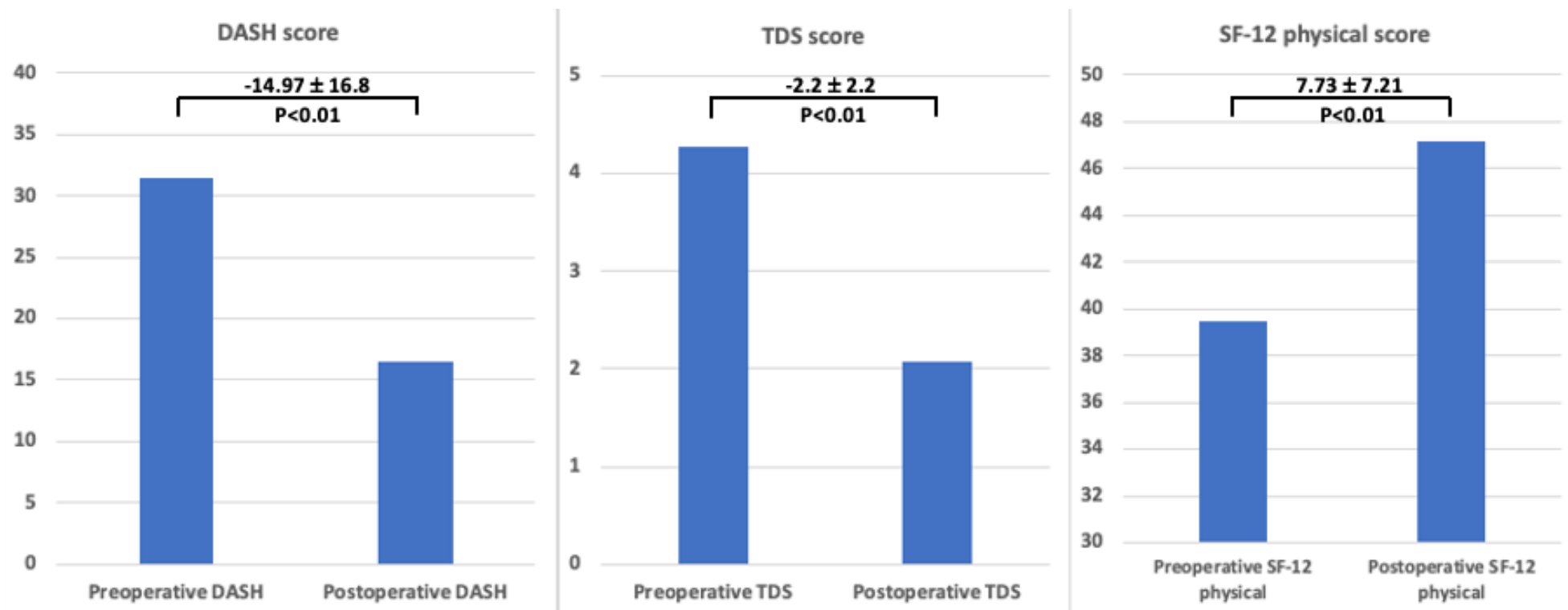
Niels Pesser, BSc,^a Aron Bode, MD, PhD,^a Jens Goeteyn, MD,^a Joris Hendriks, MD,^b Bart F. L. van Nuenen, MD, PhD,^c Karl A. Illig, MD,^d Marc R. H. M. van Sambeek, MD, PhD,^{a,e} and Joep A. W. Teijink, MD, PhD,^{a,f} Eindhoven and Maastricht, The Netherlands; and Orangeburg, SC

- Inclusie 36 chronische VTOS patiënten
- Studiedata 2015-2019
- Gemiddelde opnameduur 1.9 dagen
- Stent 5/36 sinus venous
- Complicaties: 5
 - 2 maal evacuatie hematoom
 - 1 maal actieve bloeding spier
 - 1 maal phrenicus letsel, anterieur verlopend (0.5%), onderdeel fibrotisch weefsel compressie vene
 - 1 maal passagiere Horner

Uitkomsten



- Gemiddelde follow-up 24 maanden: 83% klachtenvrij, geen retrombose



Uitkomsten



Table 62.1 Historical data regarding natural history of primary subclavian DVT

	Significant PTS symptoms (%)
Swinton et al. [2]	91
Tilney et al. [3]	74
Donayre et al. [4]	47
Gloviczki et al. [5]	40

PTS: post-thrombotic syndrome

Table 62.2 Results of aggressive operative intervention for primary ASVT

	Persistent or recurrent PTS symptoms (%)
Machleder [6]	7
Lee et al. [7]	11
Urschel and Razzuk [8]	0
Schneider et al. [9]	8
Doyle et al. [10]	5
Molina et al. [11]	0
Stone et al. [12]	14
Guzzo et al. [13]	9

Pesser et al. Surgical management of post-thrombotic syndrome in chronic venous thoracic outlet syndrome. *JVS-VL*. 2021.

CONCLUSIE



- ATOS is zeer weinig frequent
- Stenose op duplex = geen waarde!
- Operatief ingrijpen afhankelijk van specifieke casus
- UEDVT = VTOS tot tegendeel bewezen is
- Actieve behandeling met trombolyse en TATOD lijkt zinvol
 - Reductie retrombose (0-5% vs 30% in conservatieve groep)
 - Reductie Post trombotisch syndroom
 - Voorkomen levenslang antistolling
 - Trombolyse en TOD hebben acceptabele complicatie risico's
 - Operatief ingrijpen reduceert inflammatie en remodeling
- Chronische VTOS opereren is lastiger!
- Significant verbeterde functionele uitkomsten (DASH, TDS, SF-12-PH)



Vragen?

