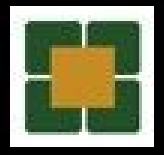
Problem-Based Decision Making

With a Little Orthotics Thrown In

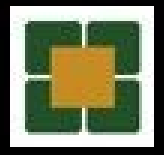
Ed Benzel
Cleveland Clinic



Repetitio Est Mater Studiorum

Repetition is the Mother of Studies (Learning)

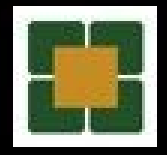
REPETITION
IS
GOOD!



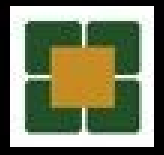
PBDM

A Clinical Decision-Making Strategy That Employs the Best Available Information and a Logic-Based Decision Making-Process

- **Separation of a Complex Problem into its Component Parts**
- **Prioritization of the Component Parts**
- **Serial Solution of the Prioritized Component Parts (Problems)**

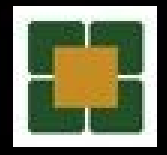


SUBOPTIMAL DECISION-MAKING



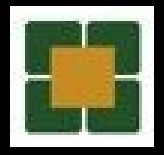
STRATEGIC ERRORS

- **Errors of consideration**
  - Errors of omission
  - Errors of logic
  - Errors of obscurity
- **Errors of prioritization**

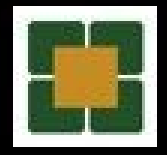


DATA GATHERING

IMPLEMENTATION



DATA GATHERING

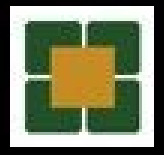


ESTABLISHMENT OF THE DIAGNOSIS

Other Data

Comorbidities
Life Expectancy
etc.
etc.
etc.....

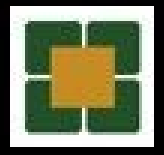
IMPLEMENTAION



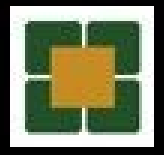
ASSUMPTION

Surgery is Indicated

Which Operation?



PROBLEM-BASED DECISION-MAKING



PBDM

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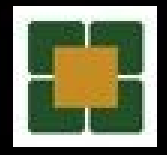
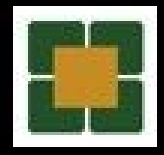


"IMPOSSIBLE"

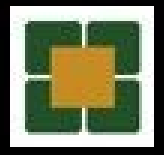
"SOLVABLE"



"OBSCURE"

"VISIBLE"

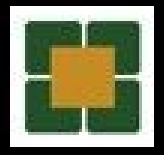
A COMPARISON of PBDM WITH EVIDENCE-BASED DECISION-MAKING



PBDM

Logic Based

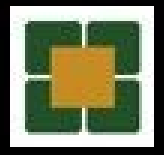
Common Sense



EVIDENCE-BASED METHODOLOGIES

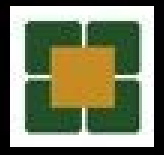
"The conscientious, explicit, and judicious use of the current best evidence in making decisions about the care of individual patients"

Sackett



"LARGE POPULATION" ASSESSMENTS

SUBPOPULATION VARIANCE

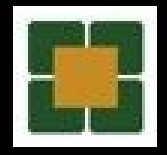


Errors of Interpretation (extrapolation)

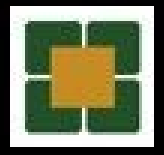
Investigator Bias

Study Design Bias

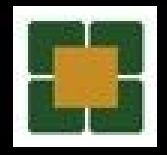
Selection Bias



Winner – Loser Bias

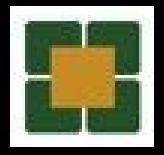


NEED
BOTH



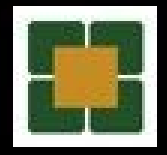
FOUNDATION OF KNOWLEDGE

(EVIDENCE-BASED DECISION-MAKING)



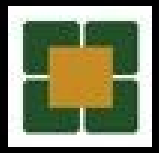
FILL THE "GAPS"

(with common sense)

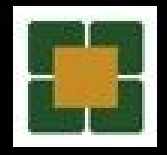


"Good doctors use both individual clinical expertise and the best available external evidence, and neither alone is enough. Without clinical expertise, practice risks becoming tyrannized by evidence, because even excellent external evidence may be inapplicable to or inappropriate for an individual patient. Without current best evidence, practice risks rapidly becoming out of date, to the detriment of patients."

Sackett DL: Evidence-Based Medicine. Spine 23:1085-1086, 1998

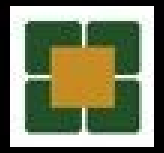


PBDM



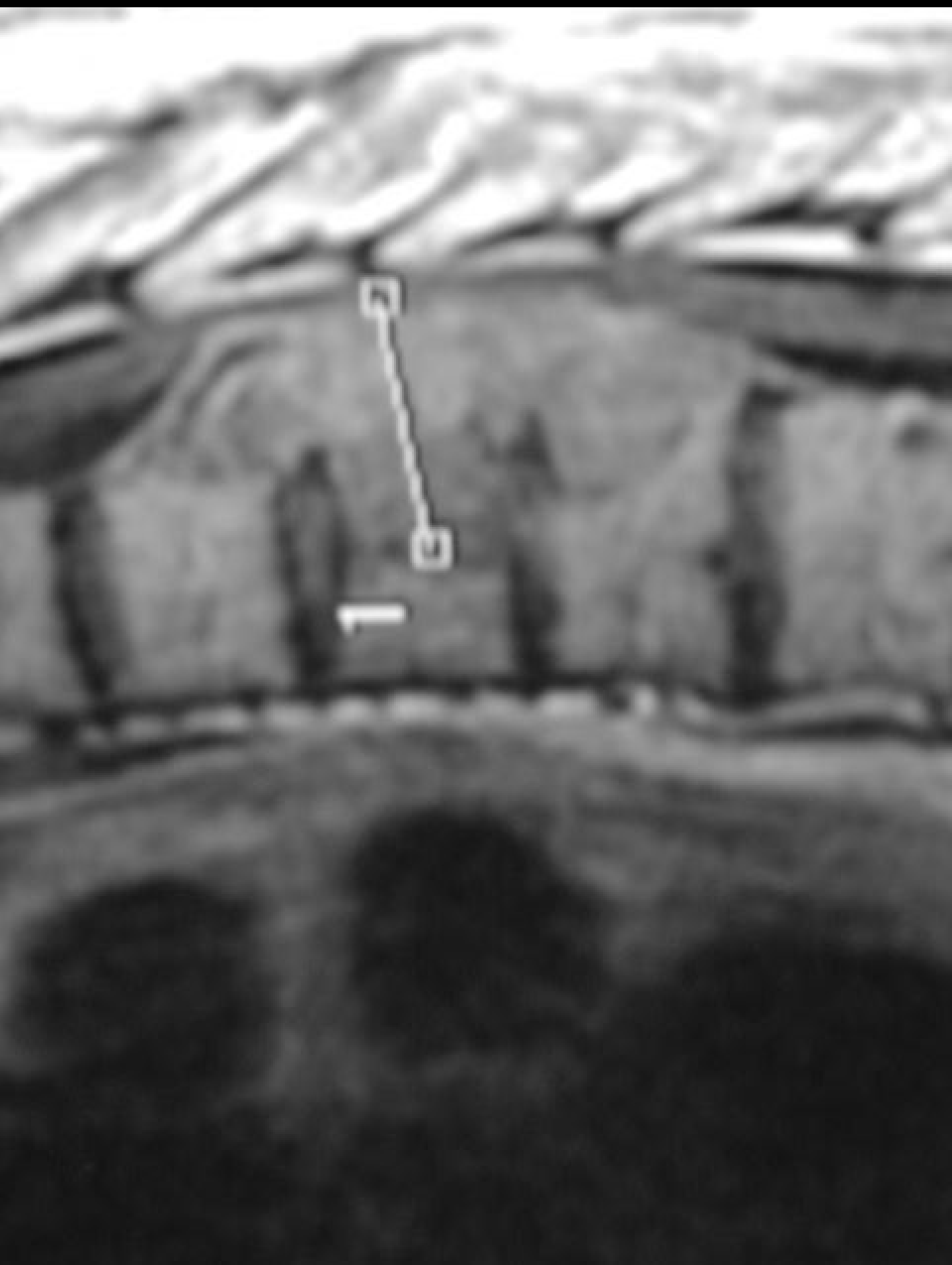
THORACOLUMBAR TRAUMA

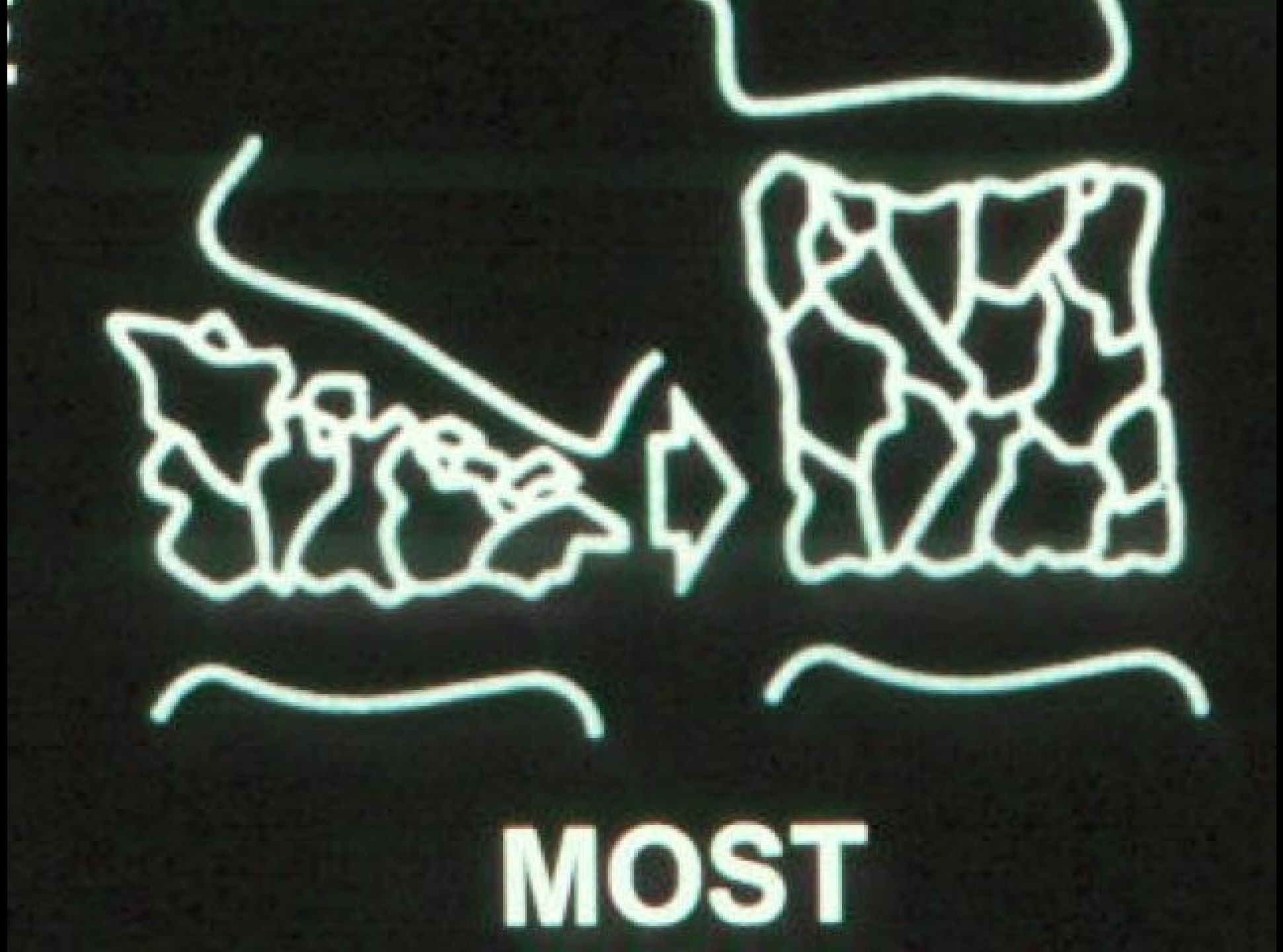
- Neurological
- Ventral Column Restoration Capacity
- Deformity Prevention

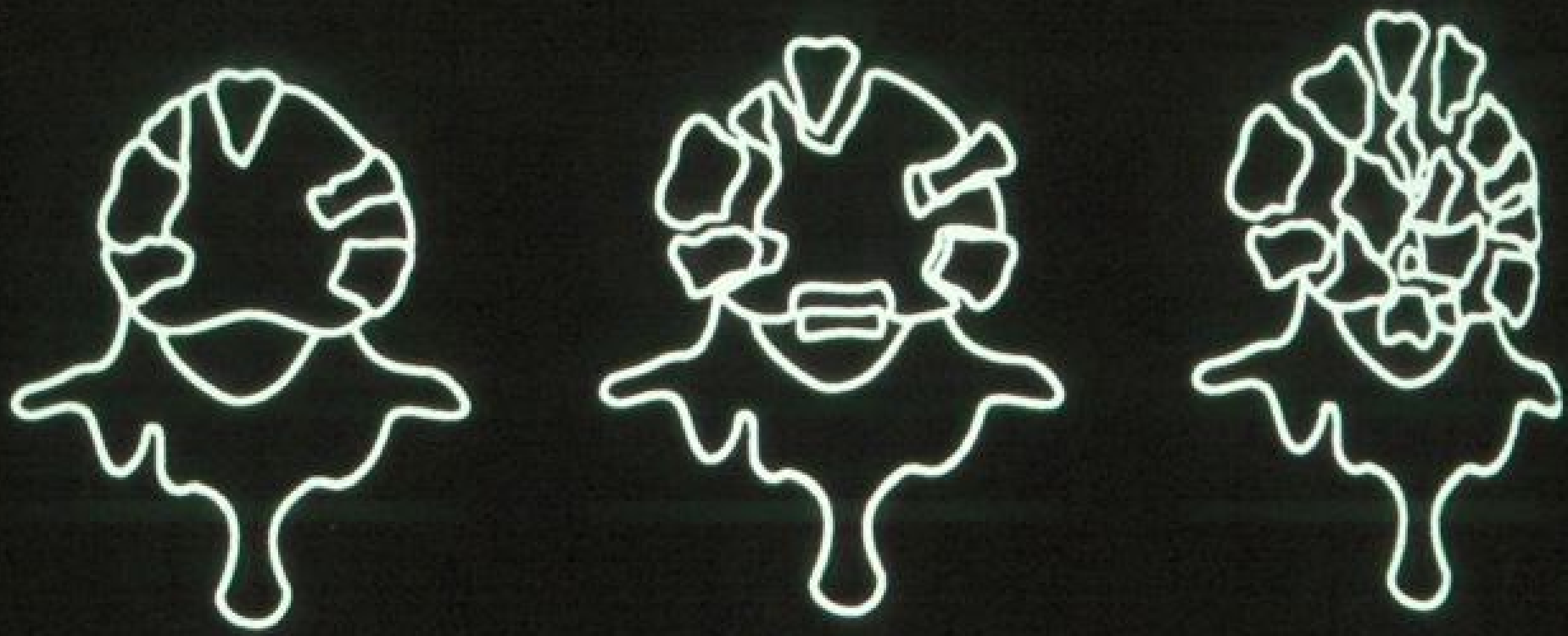


TUMOR

- Neurological
- Ventral Column Integrity
- Deformity Prevention


2
3
1


MOST

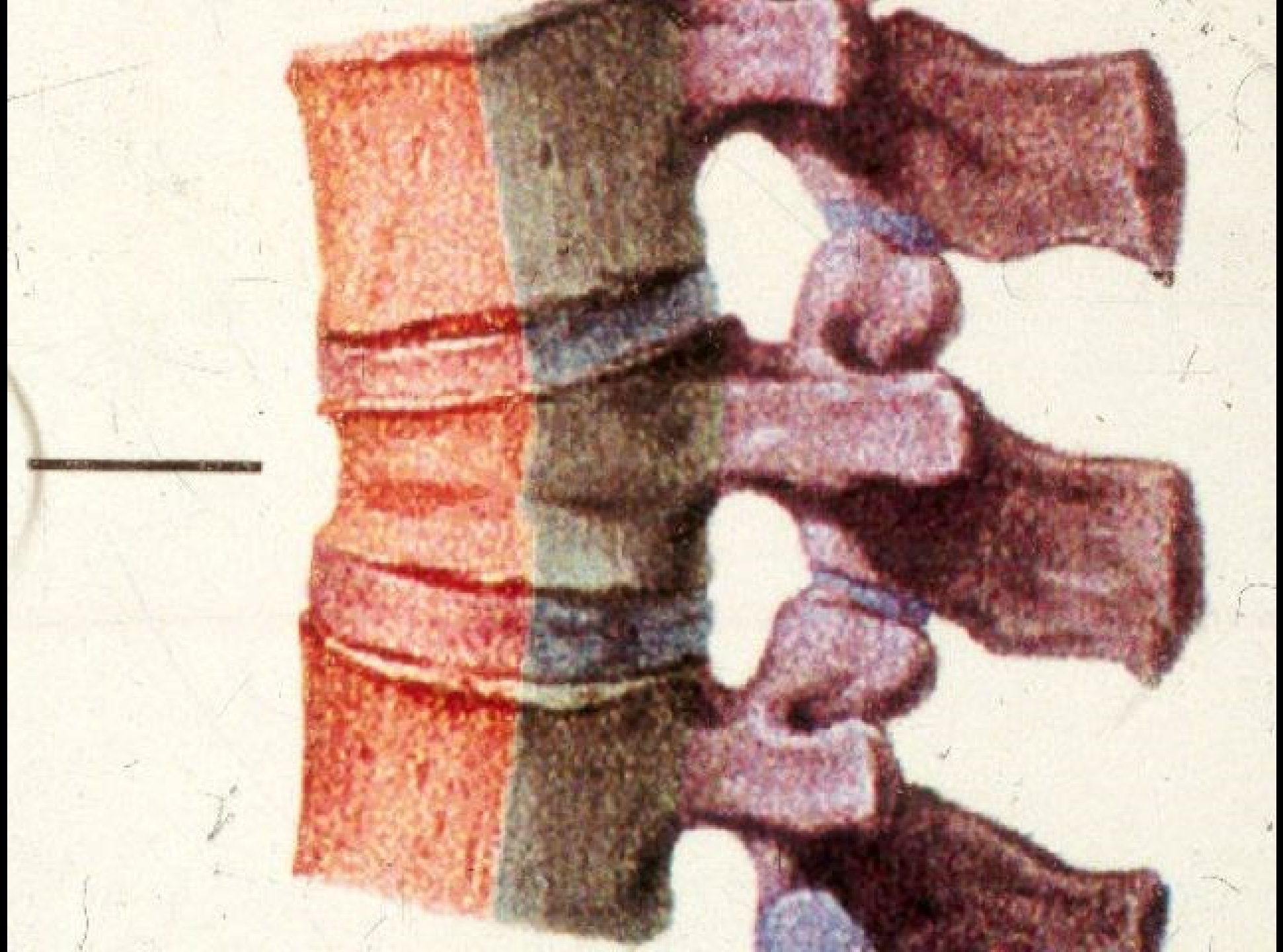


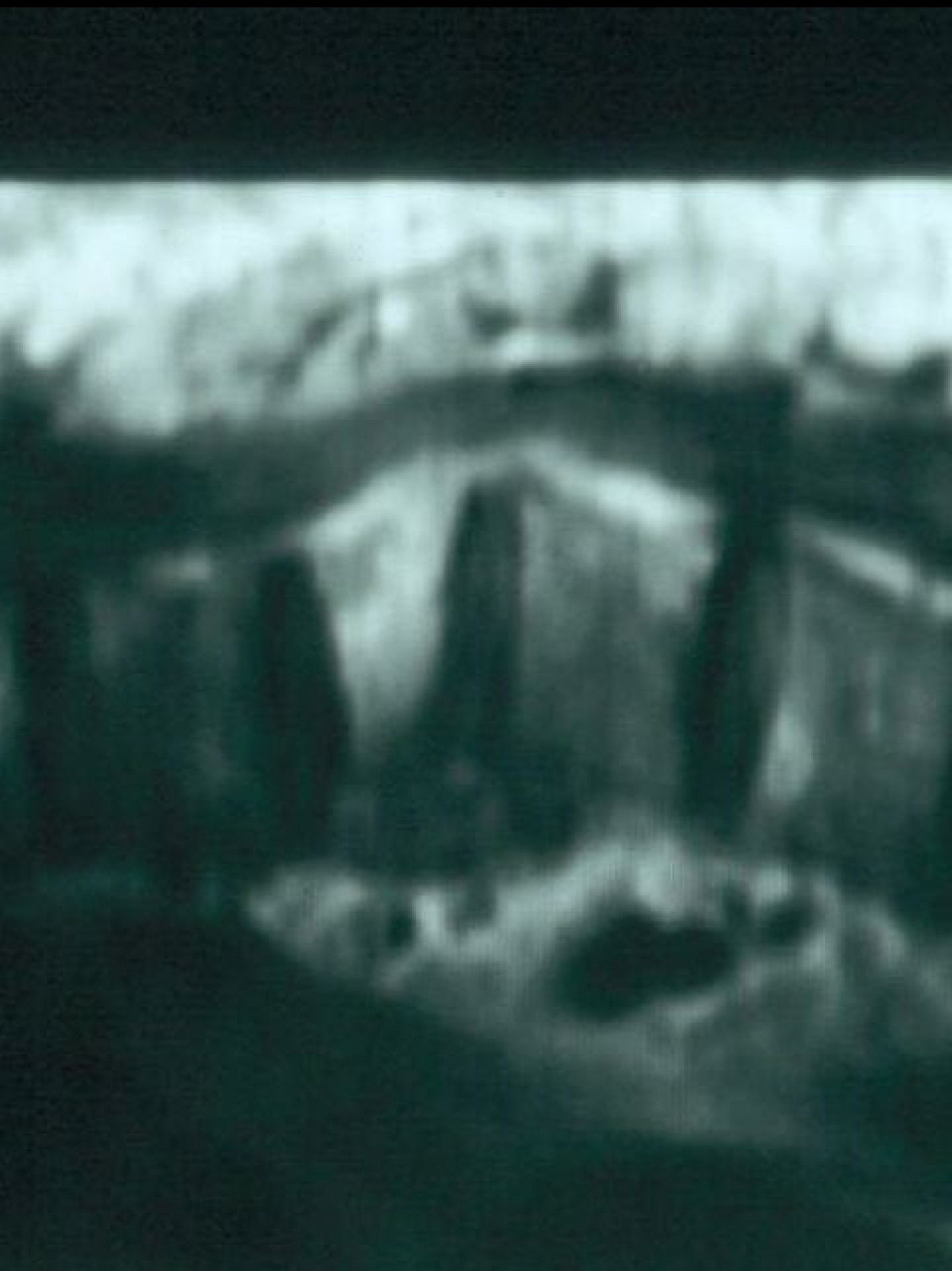
MINIMAL
1

SPREAD
2

WIDE
3


9
R
0
PHOKER I P05000





Displacement in Any Plane

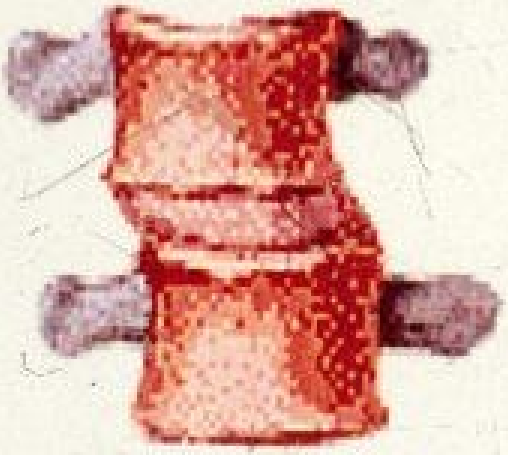
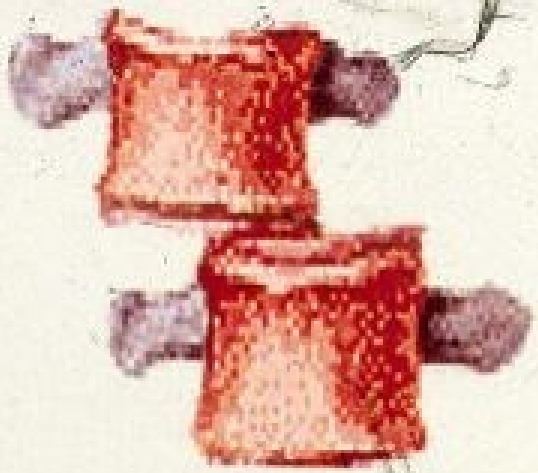


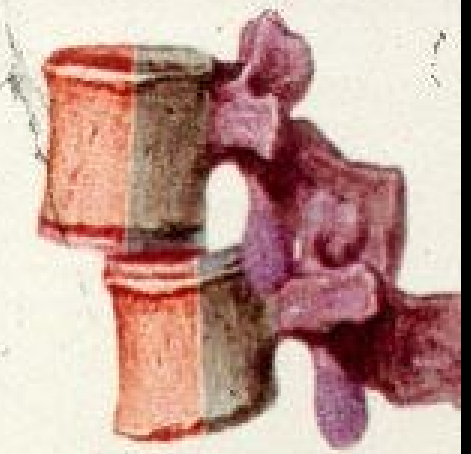
Figure -2a-

Less Than 25%

Figure -2b-



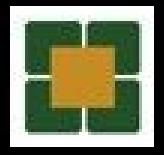
Greater Than 25%



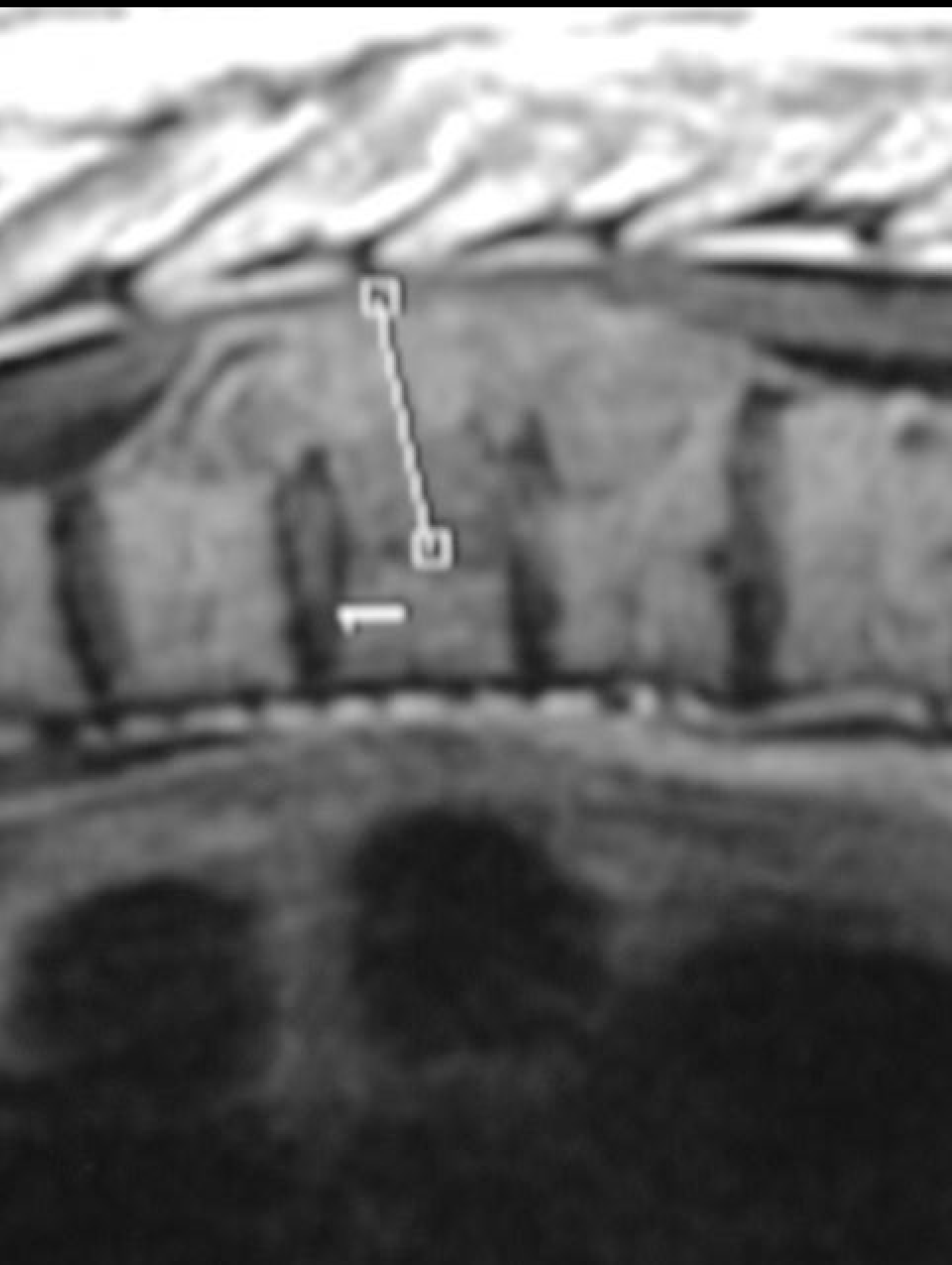
Implement Strategy in an Orderly Manner

- Consider Ventral Decompression
- Then, Consider Ventral Column Integrity
- Then Consider Deformity Resistance

- CANNOT ALTER THE ORDER




ET:2
FSE
TR:400
TE:22/Ef
CTLMID
FOV:33x33
ET:2
FSE
TR:400
TE:22/Ef
CTLMID
FOV:33x33


2
3
1


Signa 1.5T SYS4GEM1234
AE
Trumbull Memorial Hospital


Signa 1.5T SYS4GEM1234
AE
Trumbull Memorial Hospital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Trumbull Memorial Hospital


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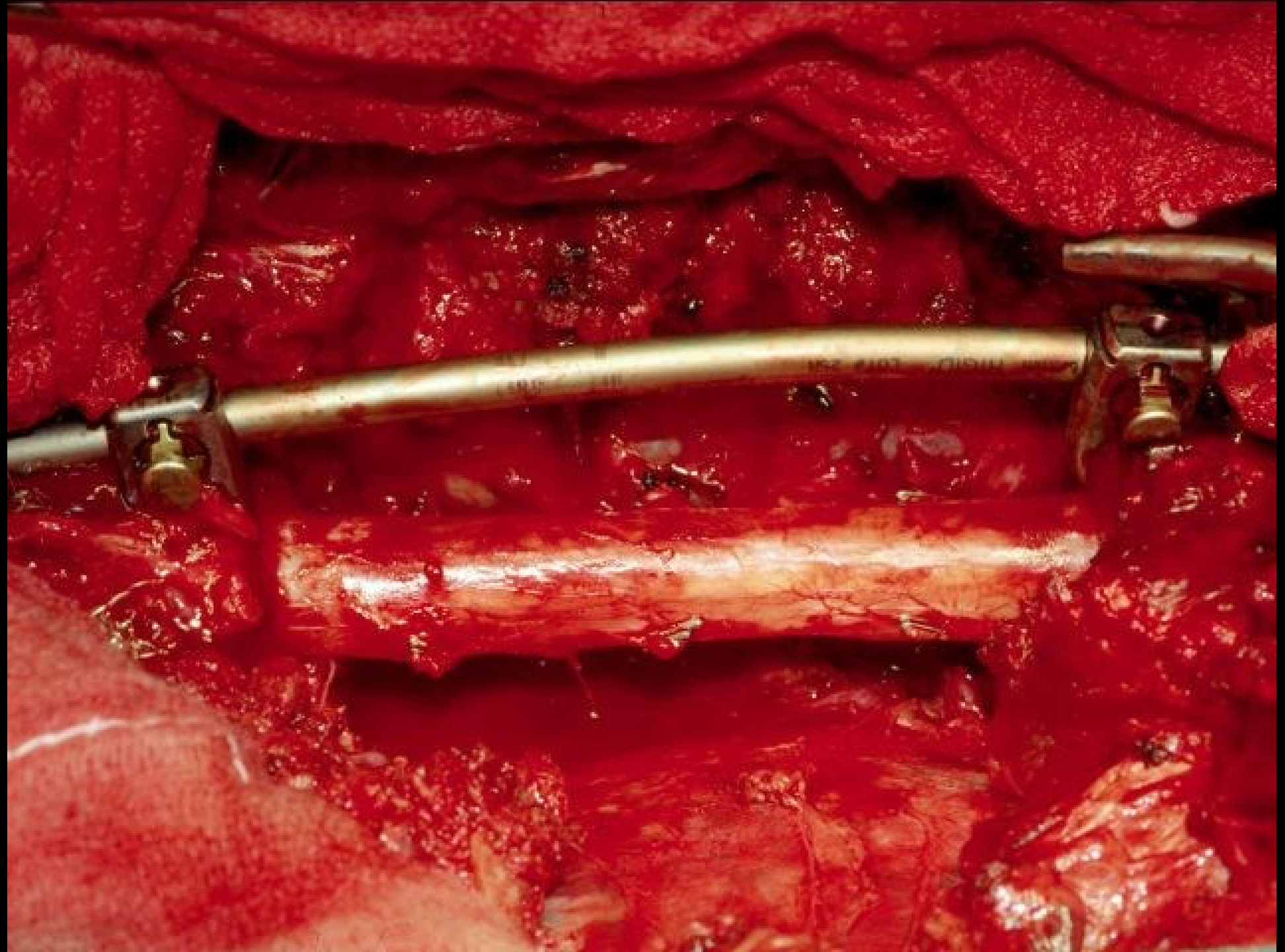

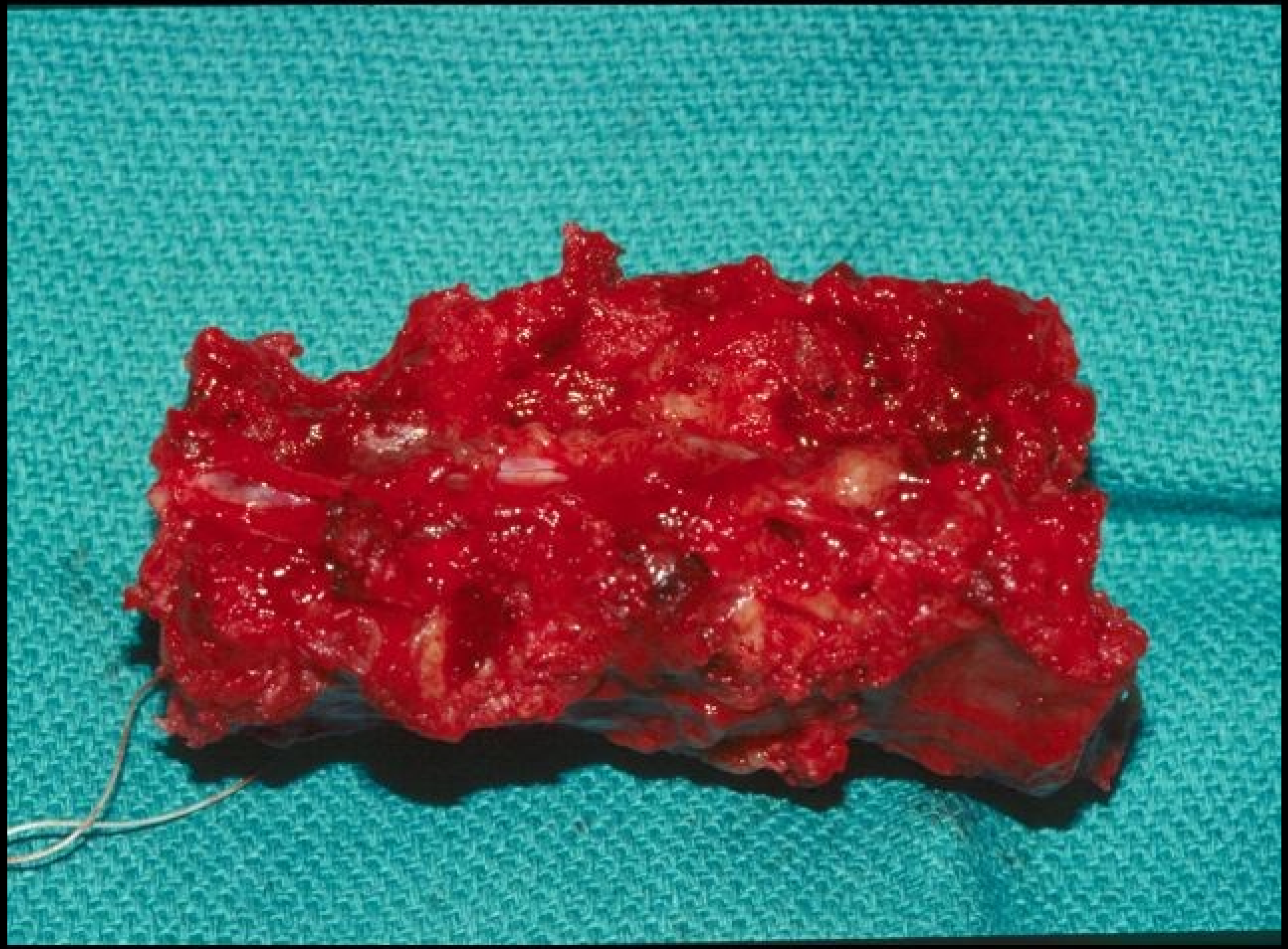

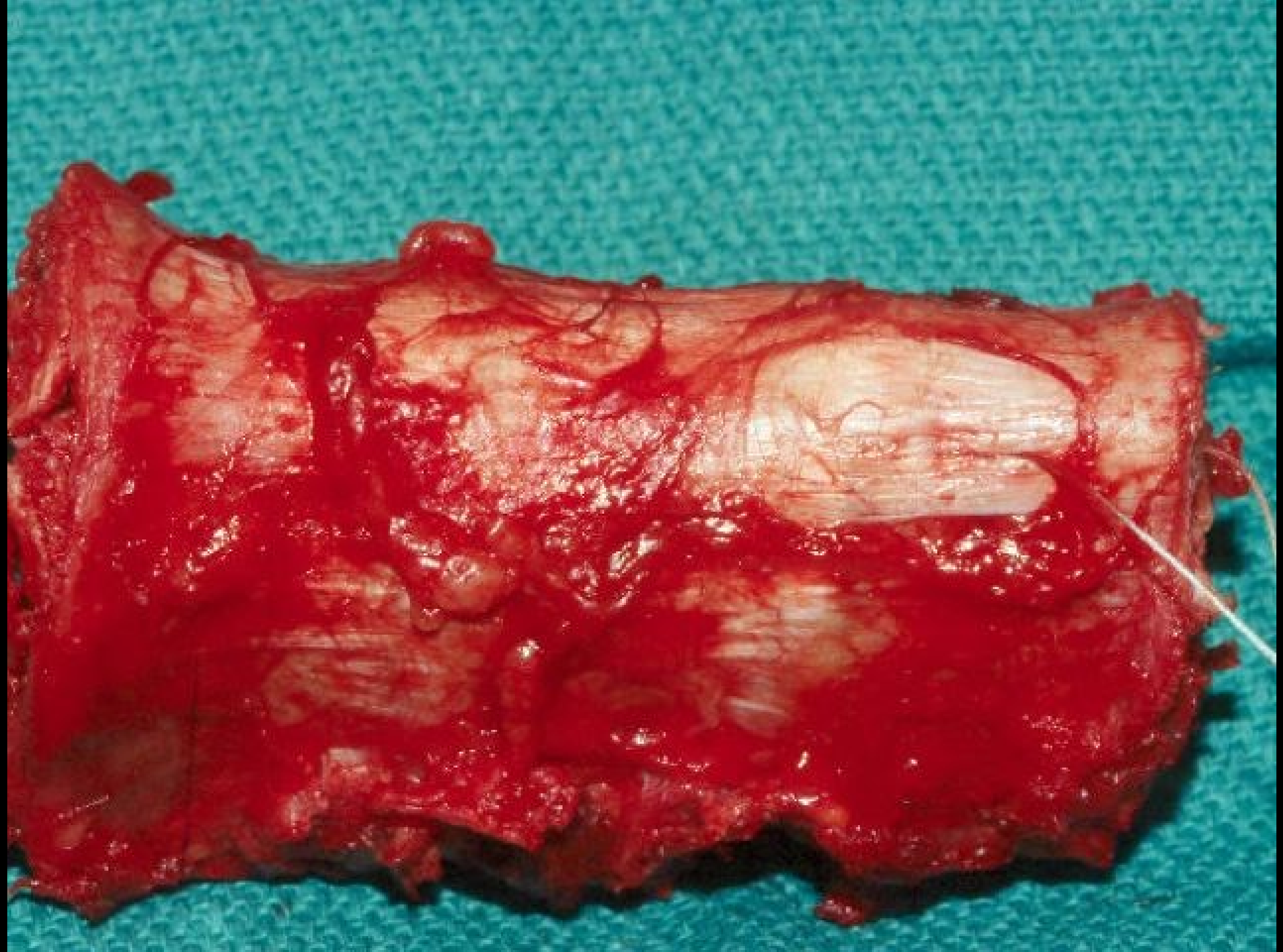

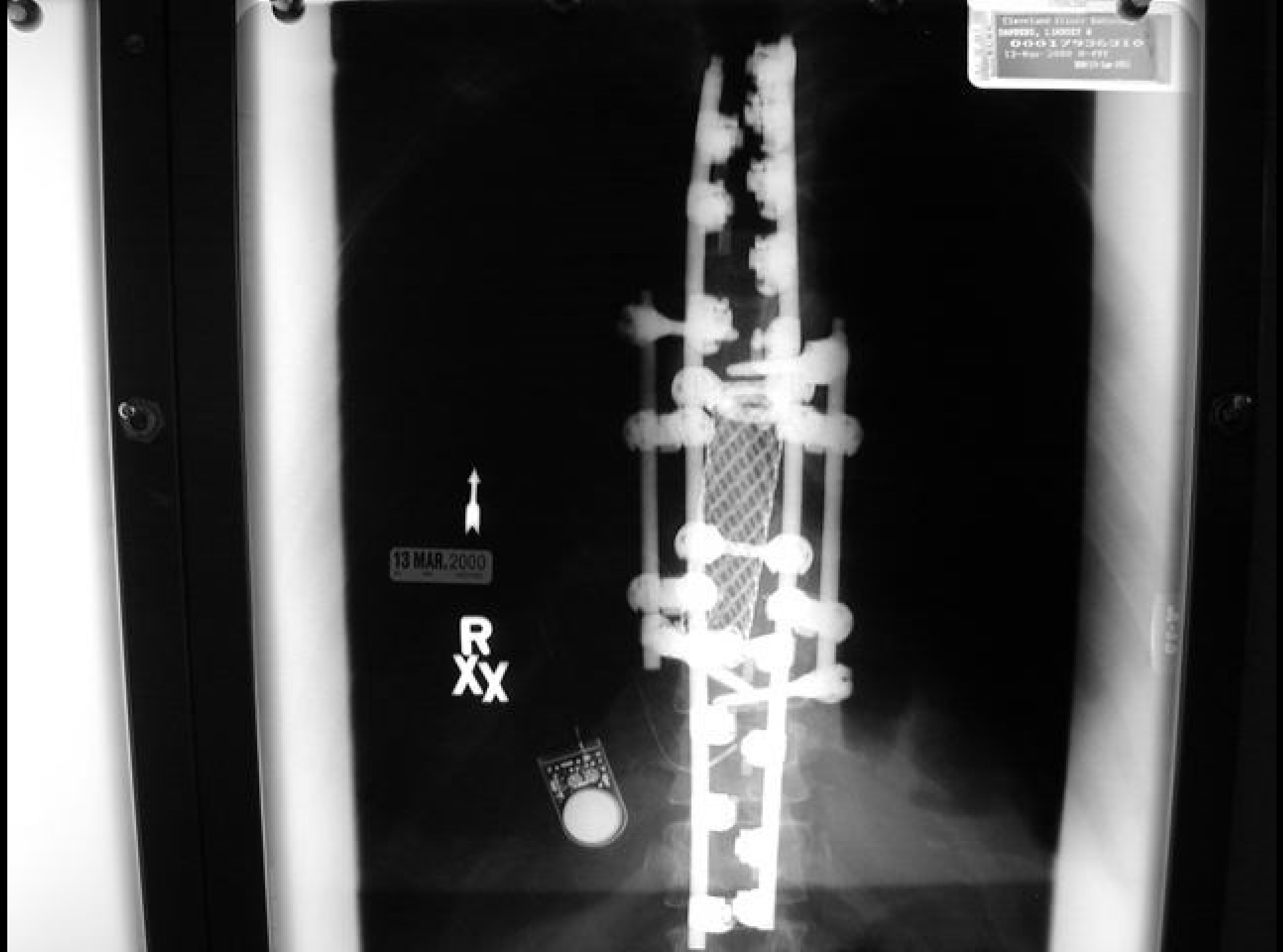
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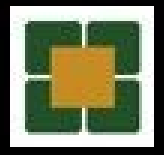
X

PBDM
Simple
?

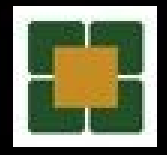
Surgical Decisions
The Human Factor



DIAGNOSIS?
CURE?
LIFE EXPECTANCY?
FEARS?
DESIRES?
EXPECTATIONS?

ART
VS.
SCIENCE

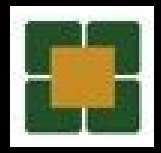
PBDM

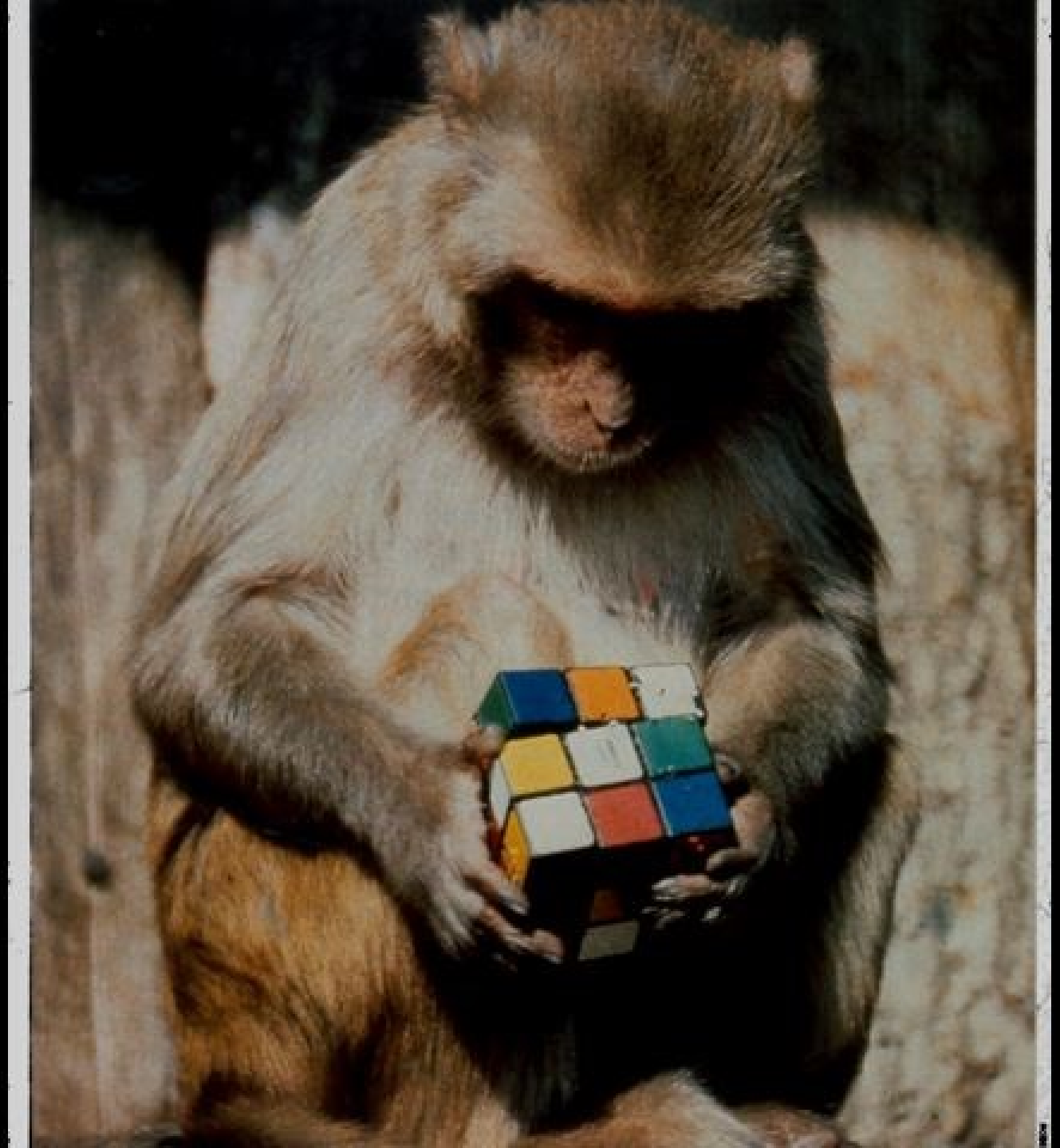


DIVIDE

PRIORITIZE

SOLVE





ORTHOTICS

Biomechanics
and
Applied Decision-Making

STABILITY

Decompression

Fusion

Instrumentation

Splint

BEDREST

BRACING

SOFT

TISSUE

GOALS

* RESTRICTION OF MOVEMENT
* SPINAL REALIGNMENT
* TRUNK SUPPORT

INDICATIONS FOR ORTHOSES

RELIEF OF PAIN BY LIMITING MOTION OR WEIGHT BEARING

IMMOBILIZATION AND PROTECTION OF WEAK OR PAINFUL MOTION SEGMENTS

REDUCTION OF AXIAL LOAD

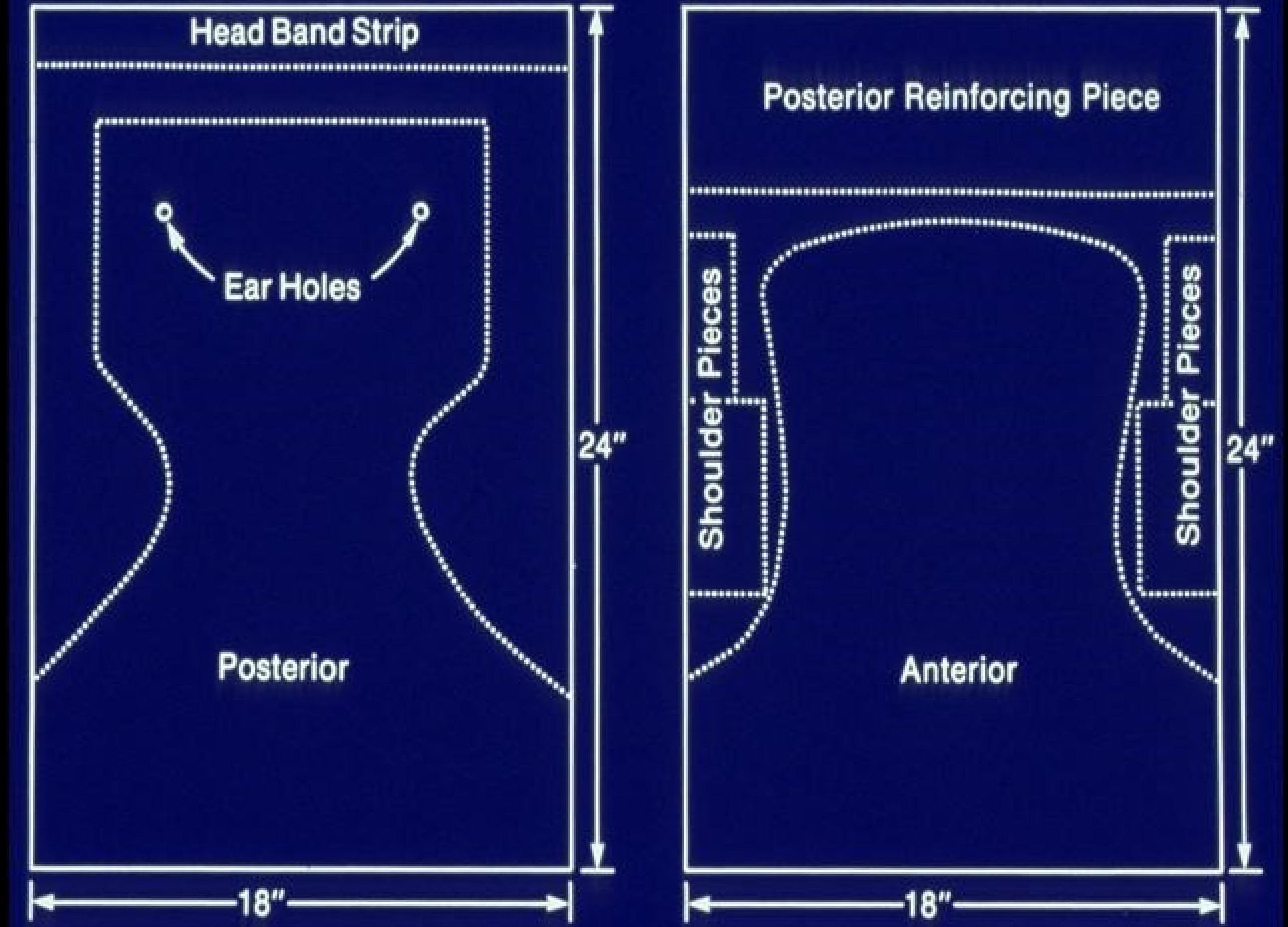
PREVENTION AND CORRECTION OF DEFORMITIES

IMPROVEMENT OF FUNCTION

THERMO PLASTICS

LOW

HIGH


Head Band Strip
Ear Holes
Posterior
24"
18"
Posterior Reinforcing Piece
Shoulder Pieces
Shoulder Pieces
Anterior
24"
18"

HIGH TEMPERATURE

STRESS

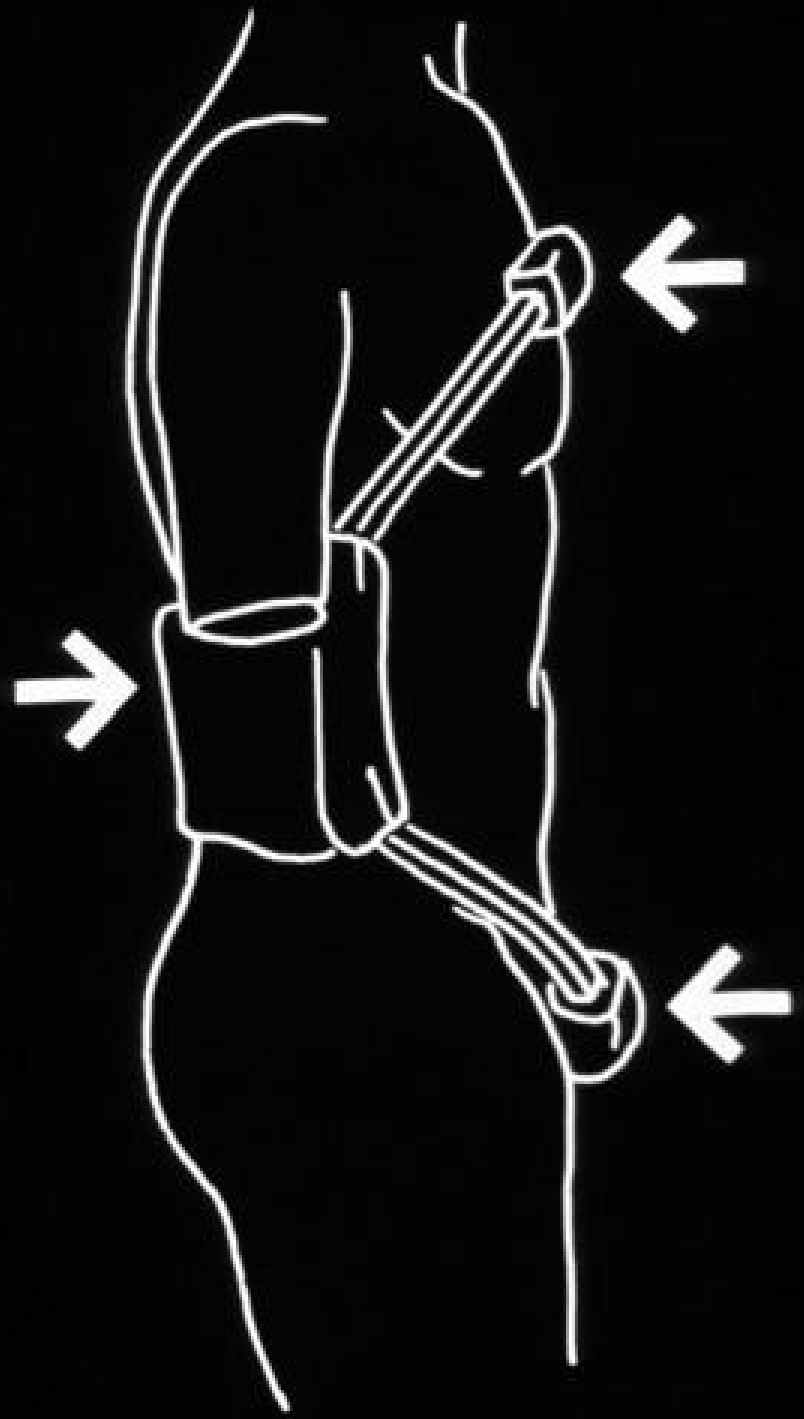
HEAT

KYDEX

POLYPROPYLENE

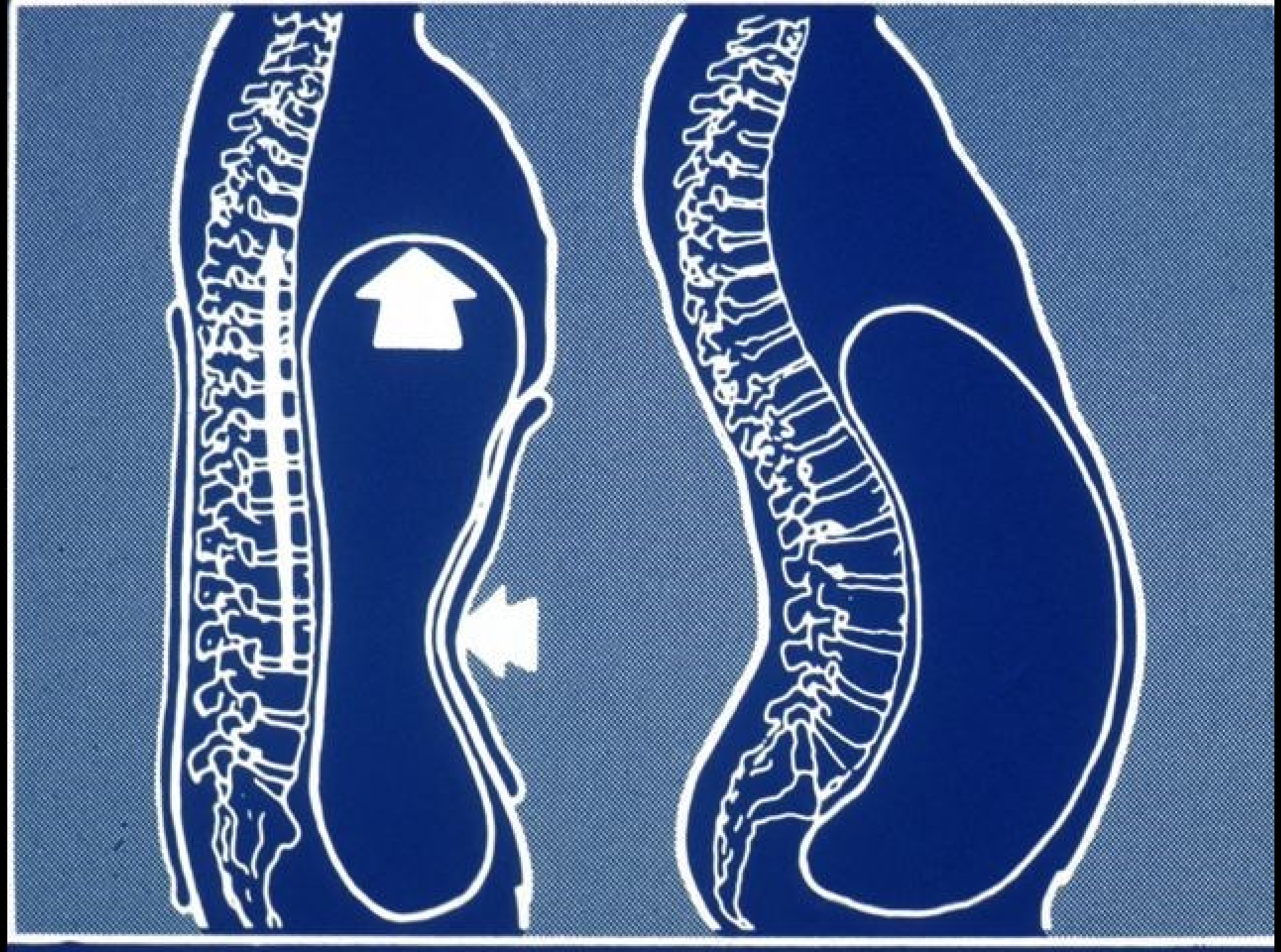
POLYETHYLENE

VITRATHENE



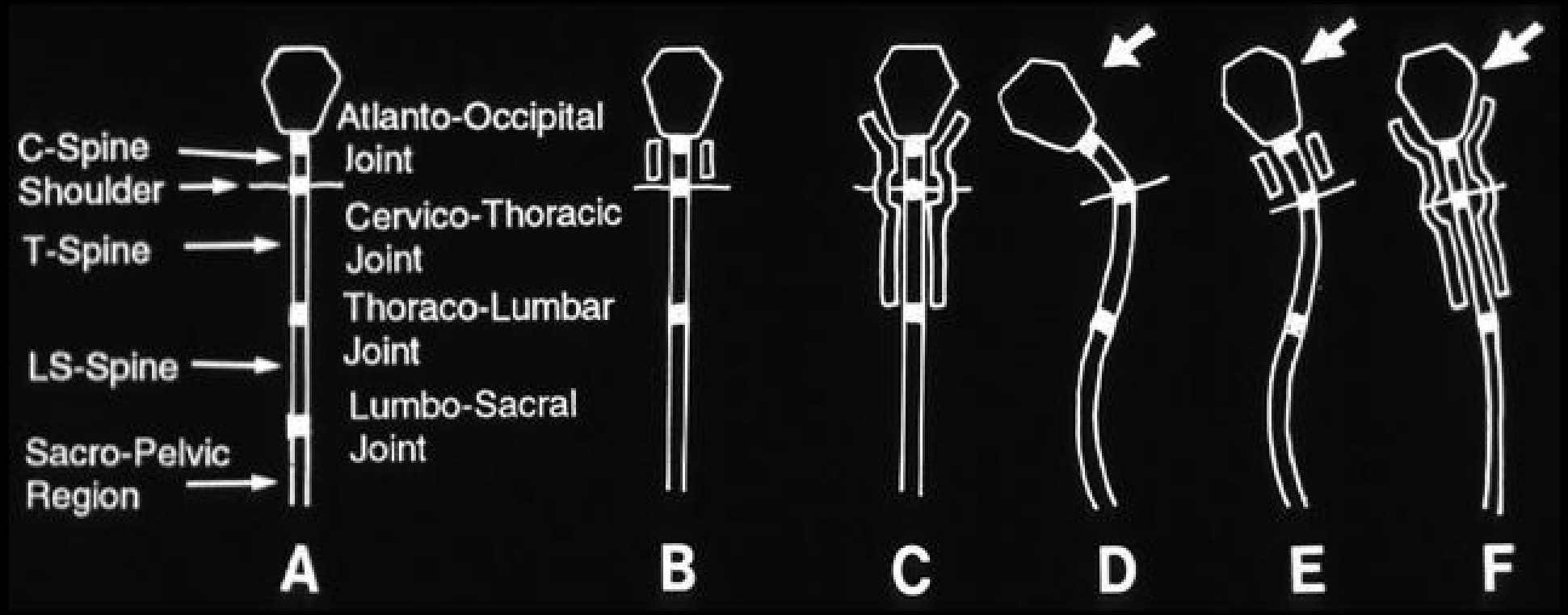
3 POINT FIXATION

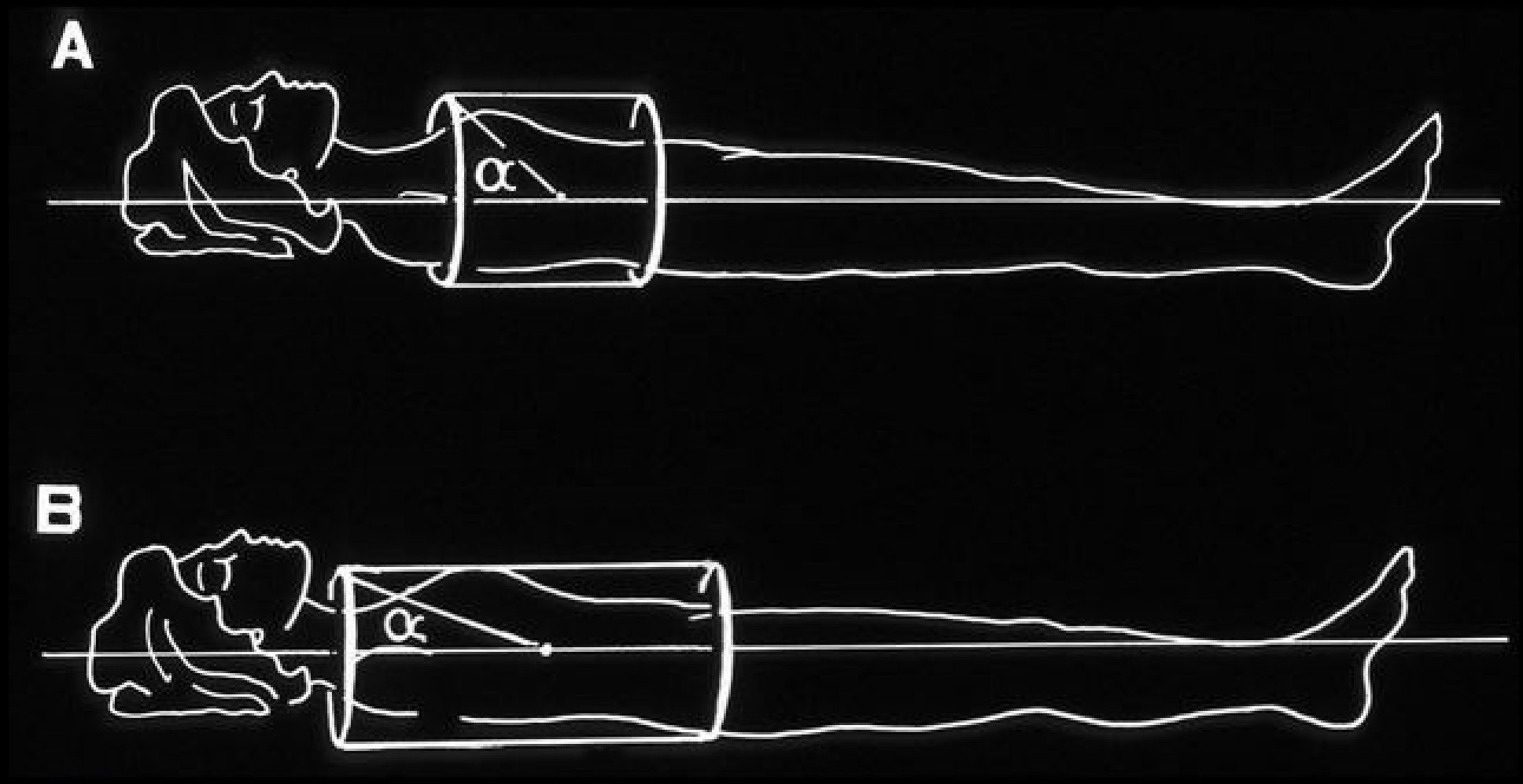
DISCOMFORT
WOUND HEALING
BODY CYLINDER
LATERAL BENDING

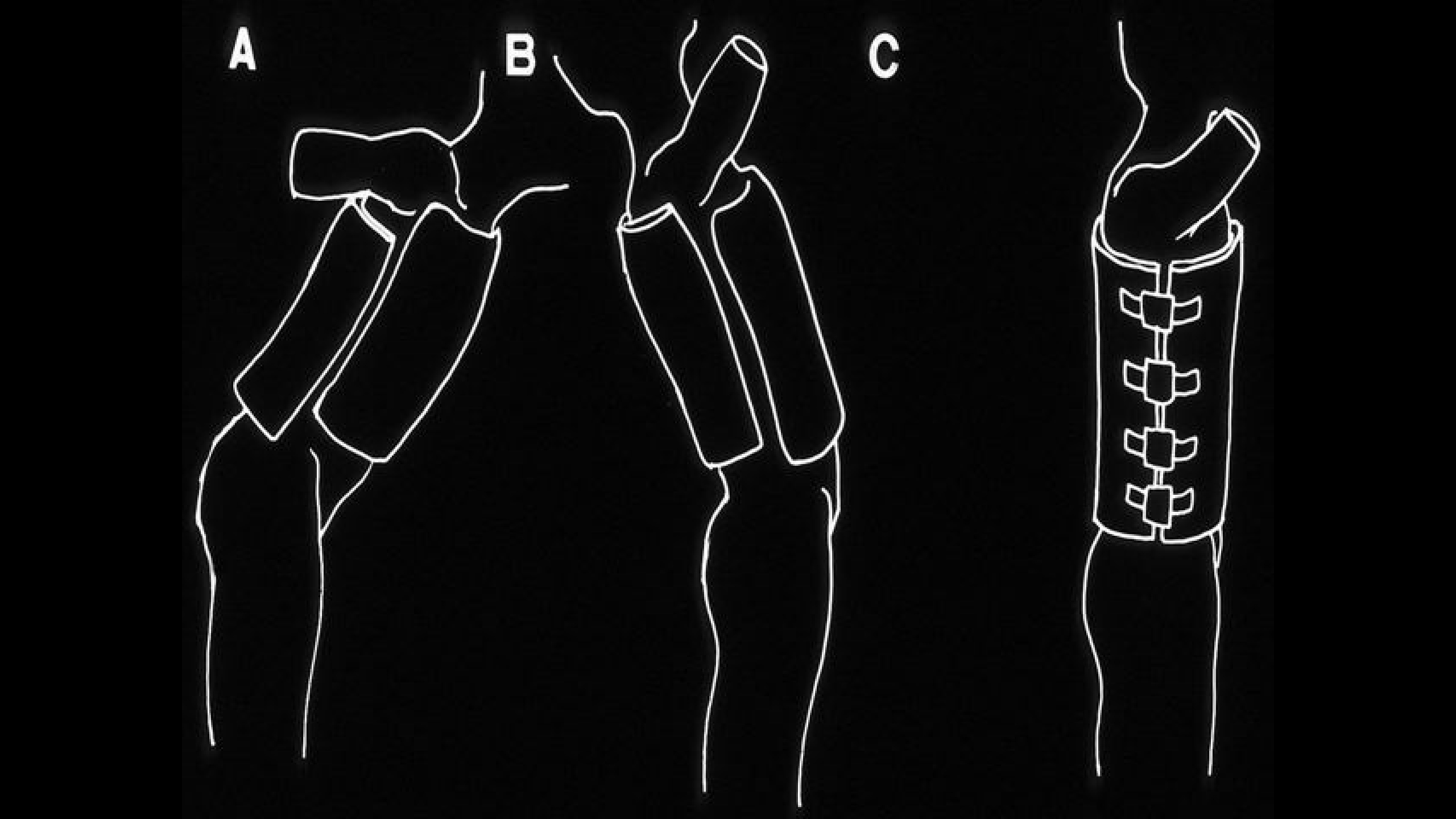


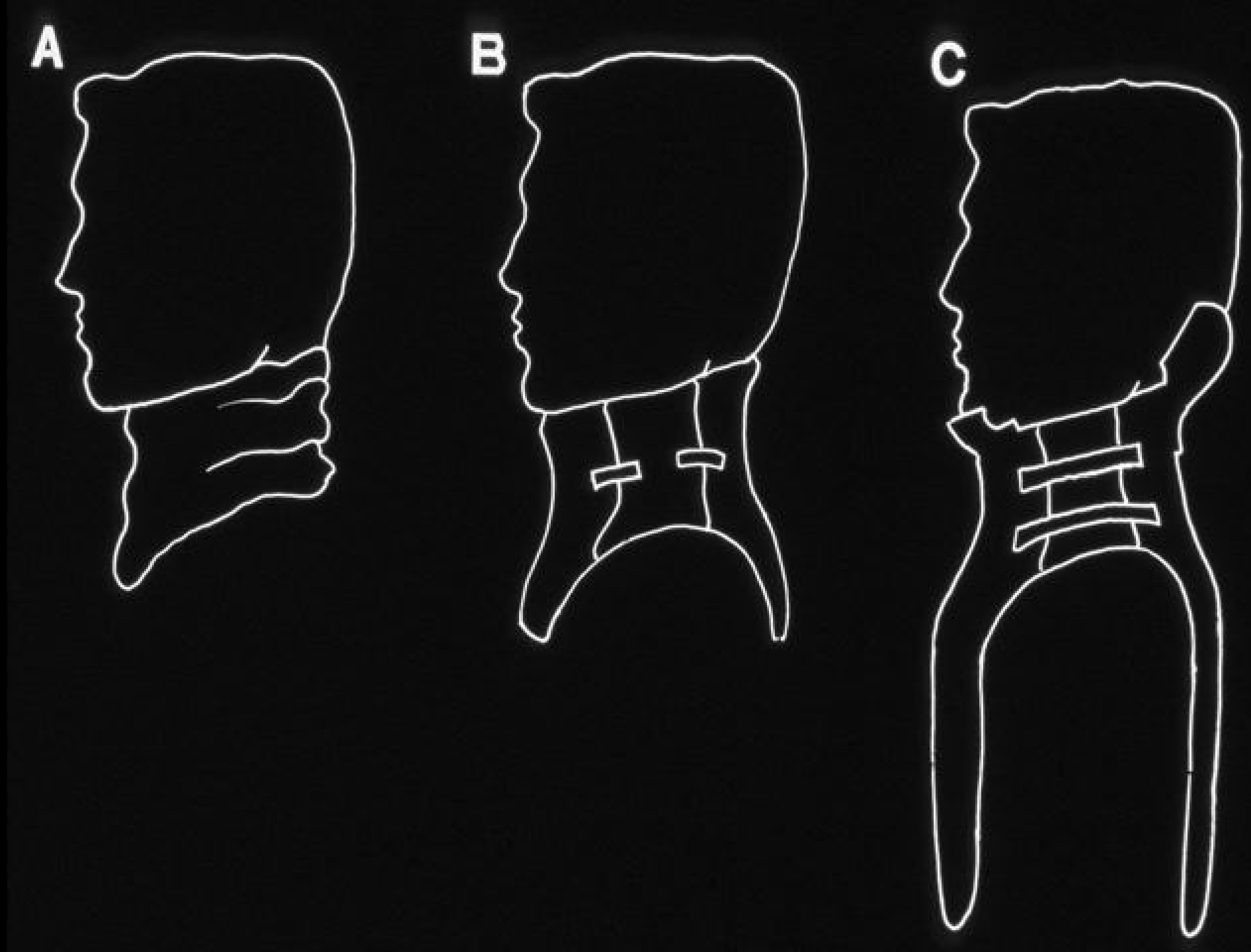
4-5

VERTEBRAL LEVELS


C-Spine
Shoulder
T-Spine
LS-Spine
Sacro-Pelvic Region
Atlanto-Occipital Joint
Cervico-Thoracic Joint
Thoraco-Lumbar Joint
Lumbo-Sacral Joint
A
B
C
D
E
F

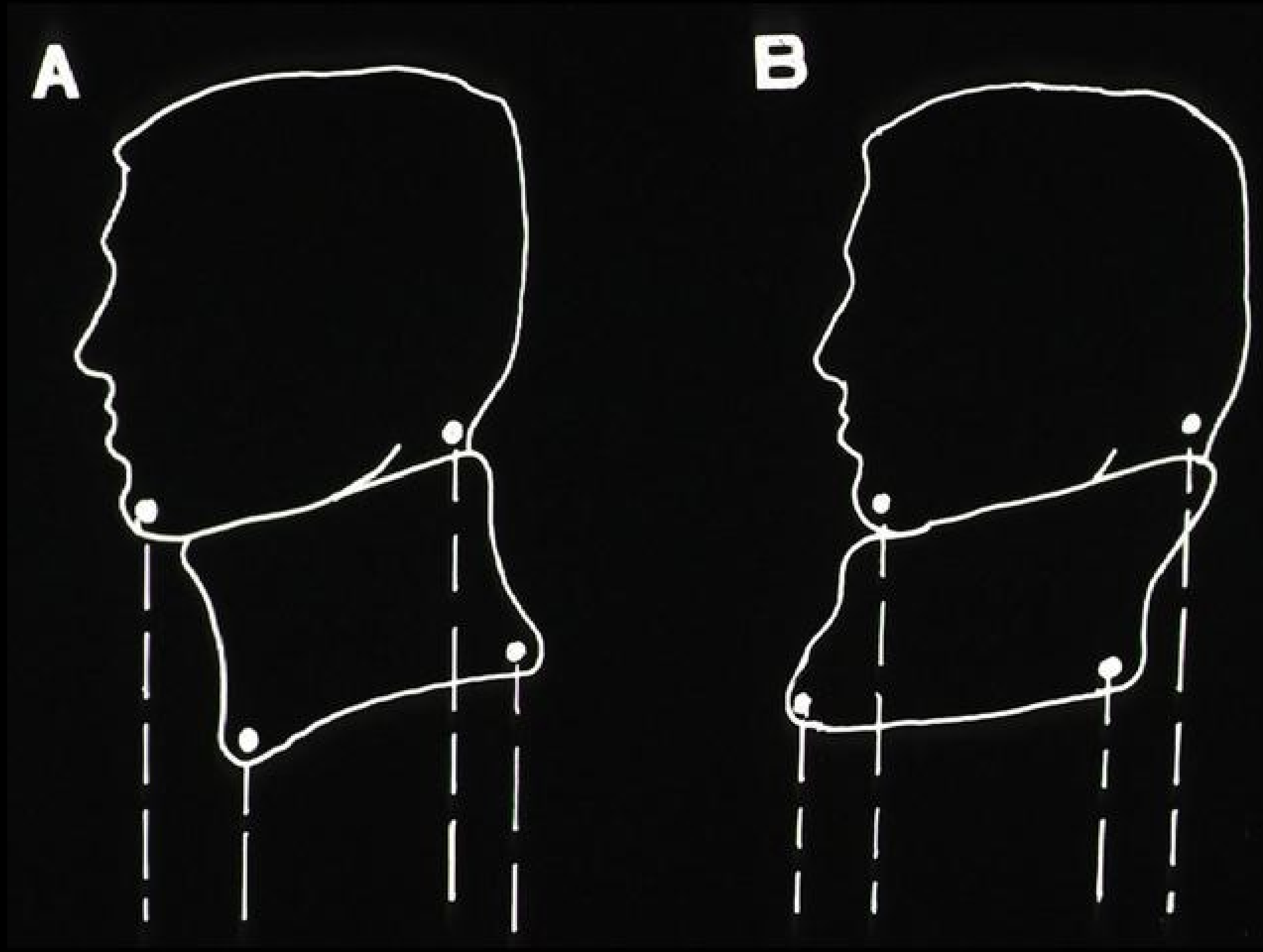

A
α
B
α


A
B
C


A
B
C


FRONT
MEDIUM 4¼


U.S. Patent Number
3,724,452


A
B

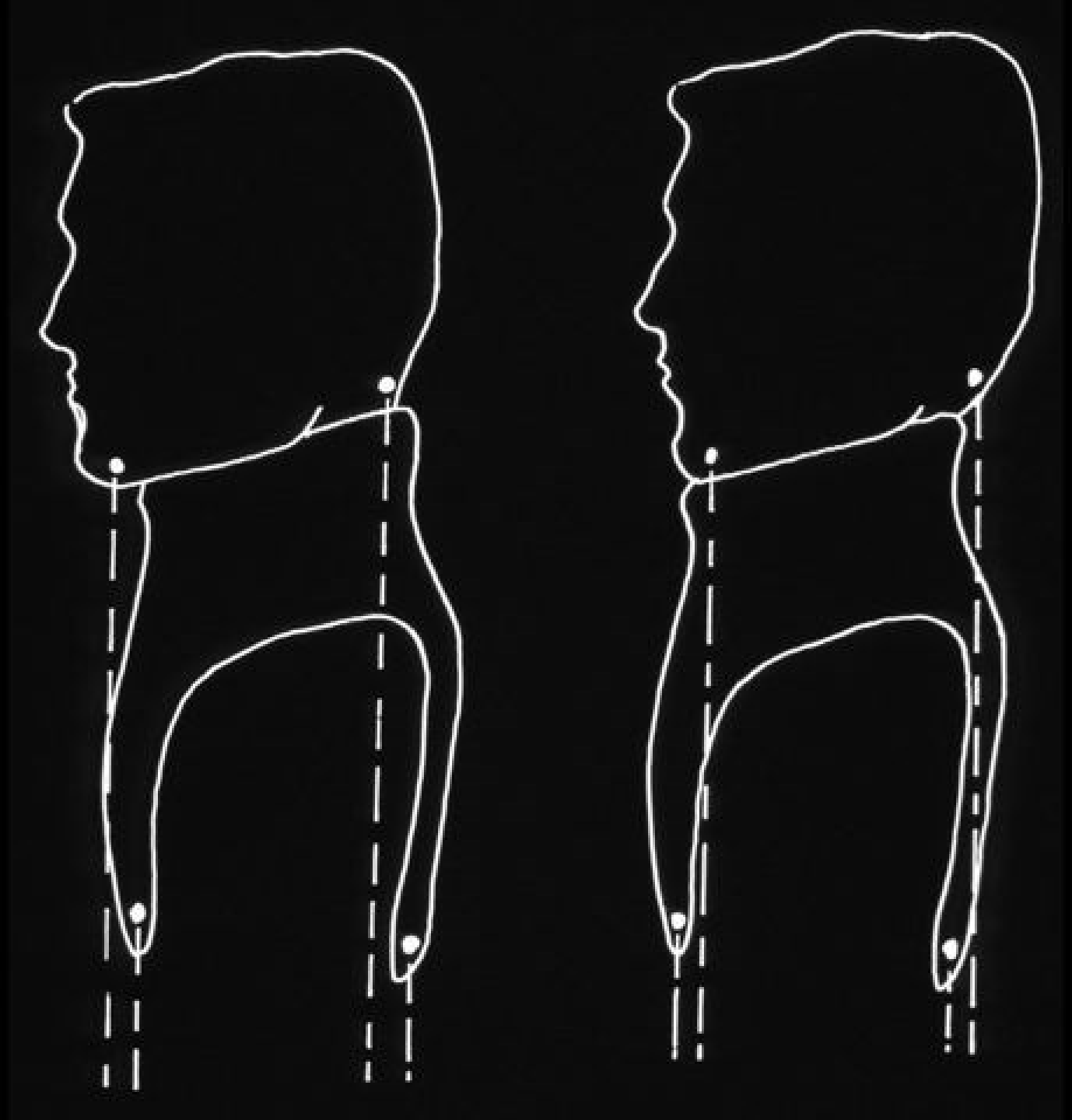
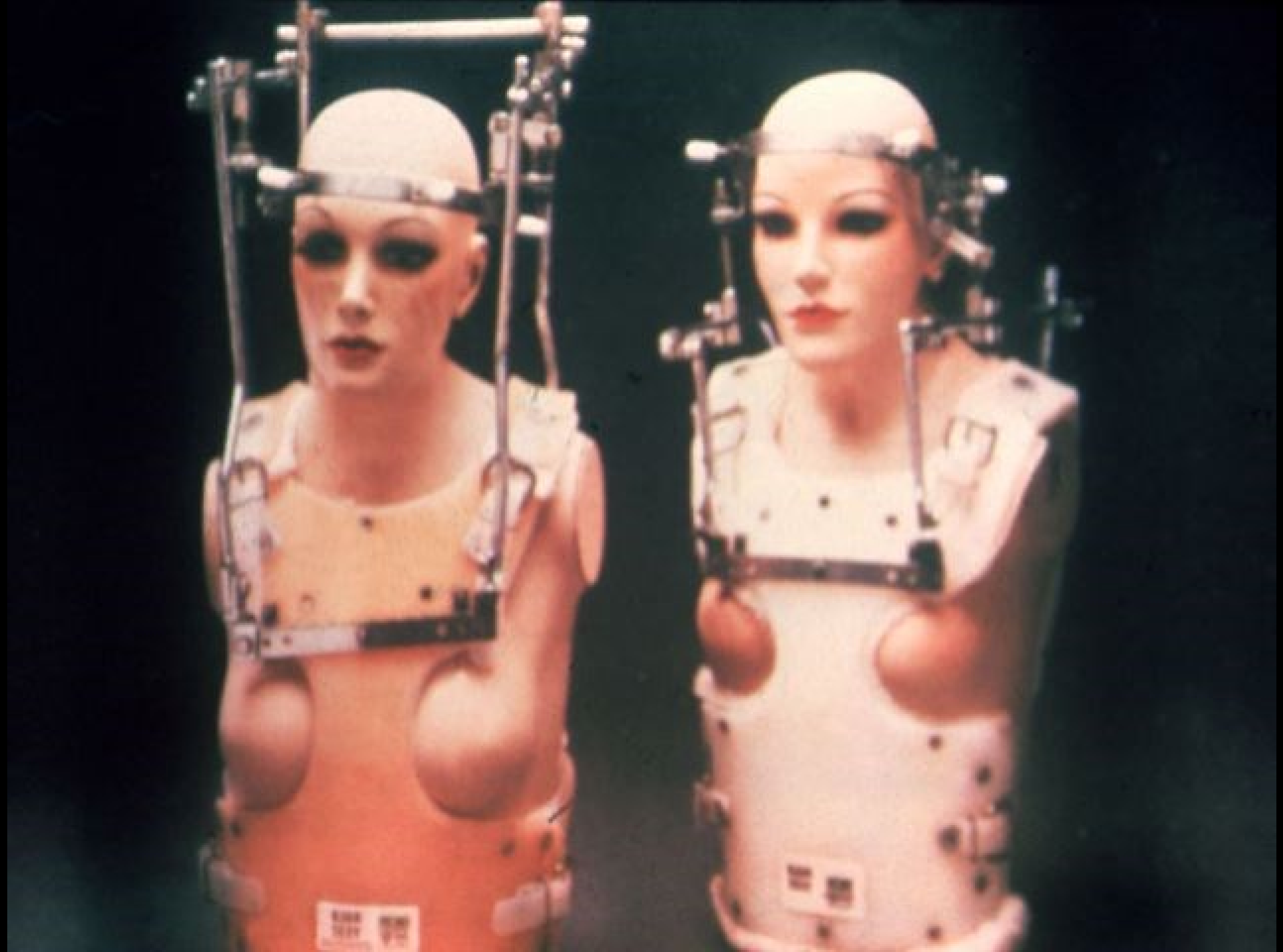
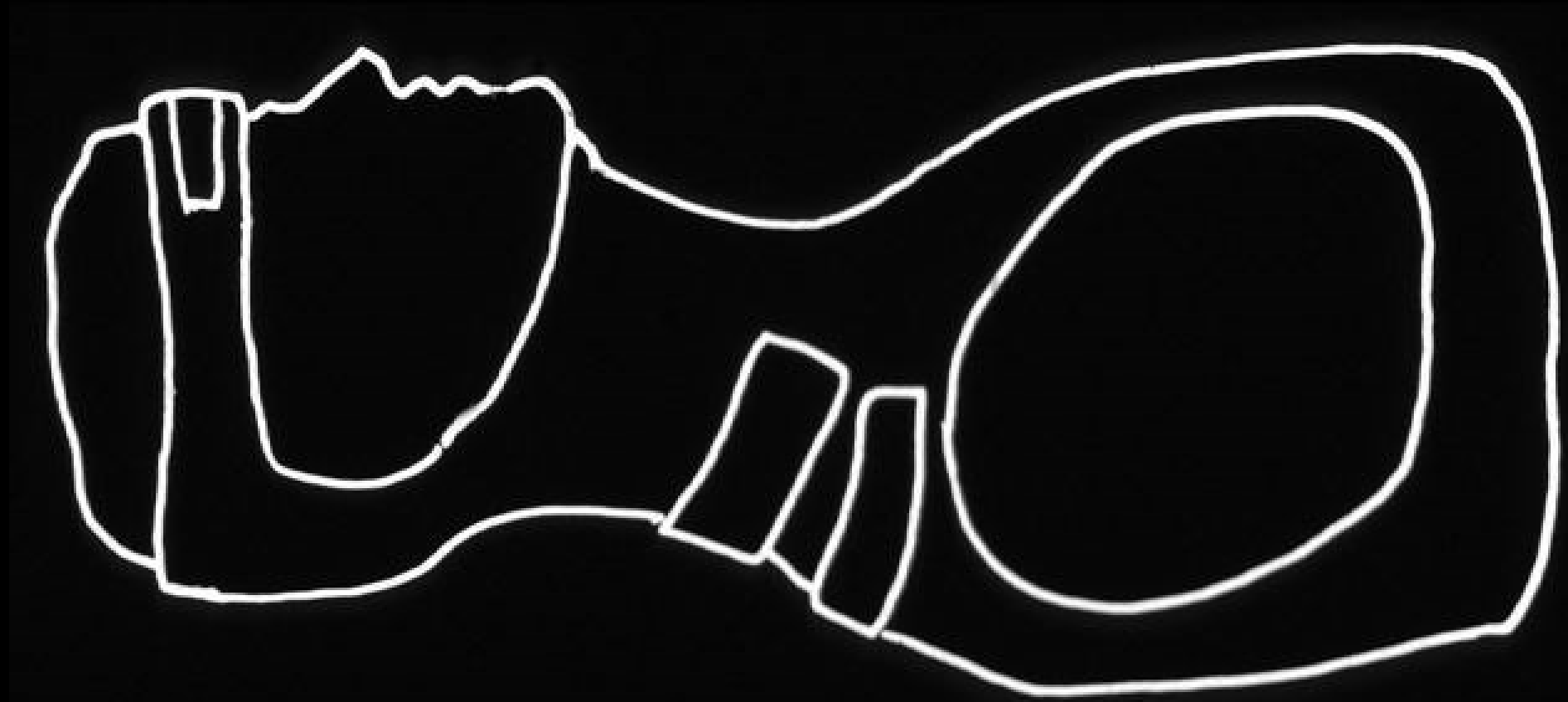


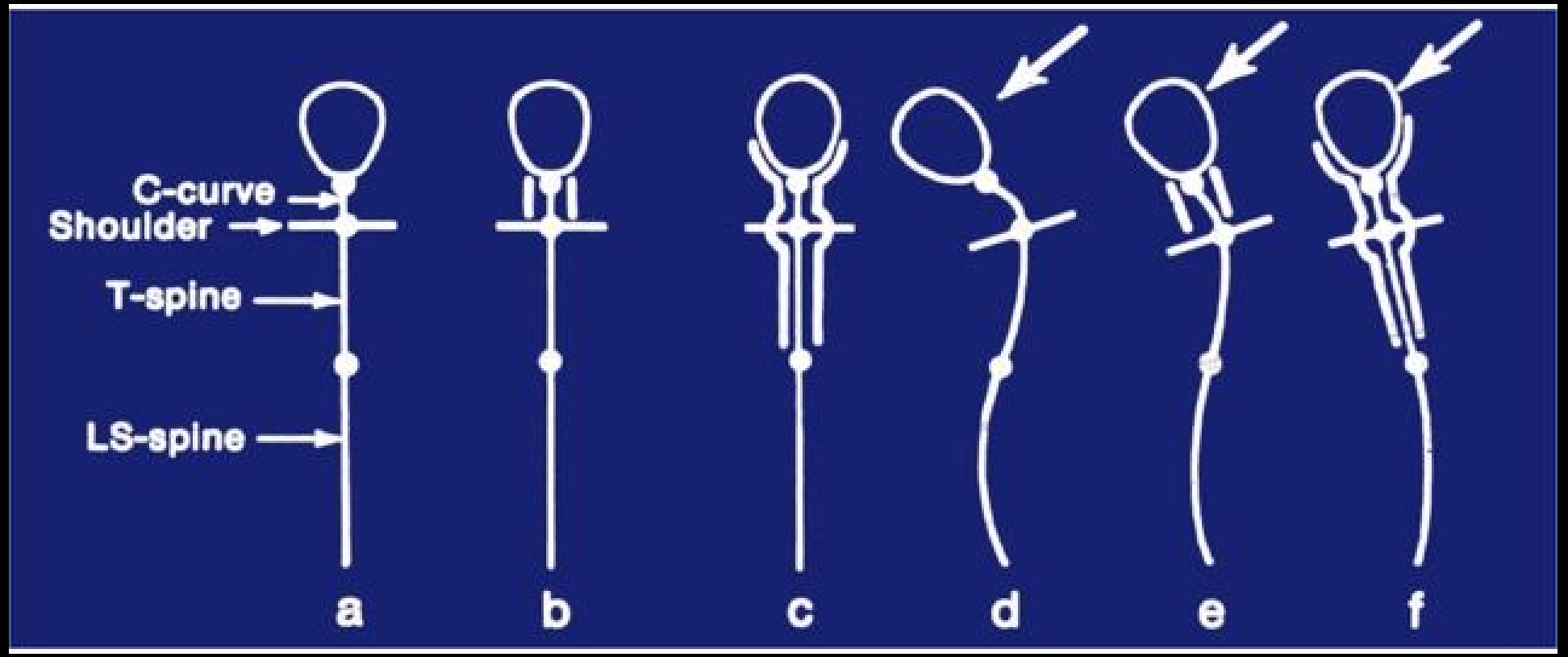
TABLE III

FLEXION AND EXTENSION ALLOWED AT EACH SEGMENTAL LEVEL (MEAN DEGREES AND 95 PER CENT CONFIDENCE LIMITS OF THE MEAN)

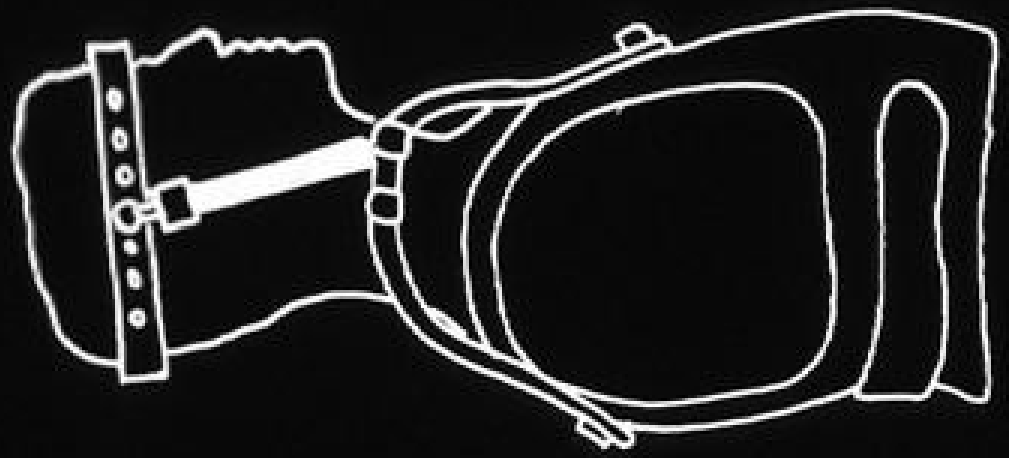
Test Situation	Motion	Occ.-C1	C1-C2	C2-C3	C3-C4	C4-C5	C5-C6	C6-C7	C7-T1
Normal unrestricted	Flexion	0.7 ± 0.5	7.7 ± 1.2	7.2 ± 0.9	9.8 ± 1.0	10.3 ± 1.0	11.4 ± 1.0	12.5 ± 1.0	9.0 ± 1.1
	Extension	18.1 ± 2.1	6.0 ± 1.2	4.8 ± 0.8	7.8 ± 1.1	9.8 ± 1.2	10.5 ± 1.3	8.2 ± 1.2	2.7 ± 0.7
Soft collar	Flexion	1.3 ± 1.3	5.1 ± 1.9	4.5 ± 1.2	7.4 ± 1.5	8.4 ± 2.4	9.9 ± 1.7	9.7 ± 0.9	7.7 ± 2.5
	Extension	13.7 ± 3.5	1.9 ± 1.4	3.9 ± 1.0	5.8 ± 1.7	6.8 ± 1.6	7.8 ± 1.2	7.4 ± 1.4	2.8 ± 1.9
Philadelphia collar	Flexion	0.9 ± 1.0	4.0 ± 1.8	1.6 ± 1.0	3.1 ± 1.1	4.6 ± 1.8	6.2 ± 1.9	6.2 ± 1.6	5.5 ± 1.8
	Extension	6.8 ± 2.2	4.5 ± 1.5	1.8 ± 0.9	3.4 ± 1.0	5.8 ± 1.2	5.9 ± 1.2	5.8 ± 2.0	1.3 ± 0.9
Somi brace	Flexion	3.6 ± 1.8	2.7 ± 1.8	0.9 ± 0.7	1.6 ± 1.1	1.9 ± 0.8	2.8 ± 1.2	2.9 ± 1.6	3.1 ± 1.8
	Extension	9.1 ± 2.6	5.4 ± 1.9	4.4 ± 1.1	6.3 ± 1.4	6.0 ± 1.8	6.0 ± 2.0	5.6 ± 1.8	2.1 ± 1.1
Four-poster brace	Flexion	2.9 ± 2.0	4.4 ± 2.1	1.6 ± 1.0	2.1 ± 1.1	1.8 ± 0.9	3.0 ± 1.2	3.9 ± 1.6	2.8 ± 1.4
	Extension	9.3 ± 2.2	3.2 ± 1.4	2.0 ± 0.7	3.2 ± 1.2	3.4 ± 1.3	2.9 ± 0.9	3.1 ± 1.5	1.6 ± 0.8
Cervicothoracic brace	Flexion	1.3 ± 0.9	5.0 ± 1.9	1.8 ± 0.8	2.9 ± 1.2	2.8 ± 0.7	1.6 ± 0.8	0.7 ± 0.6	2.4 ± 1.0
	Extension	8.4 ± 2.1	2.5 ± 0.8	2.1 ± 0.7	1.6 ± 0.7	2.2 ± 0.9	2.8 ± 0.9	3.4 ± 1.1	1.7 ± 0.8






C-curve
Shoulder
T-spine
LS-spine
a
b
c
d
e
f

A



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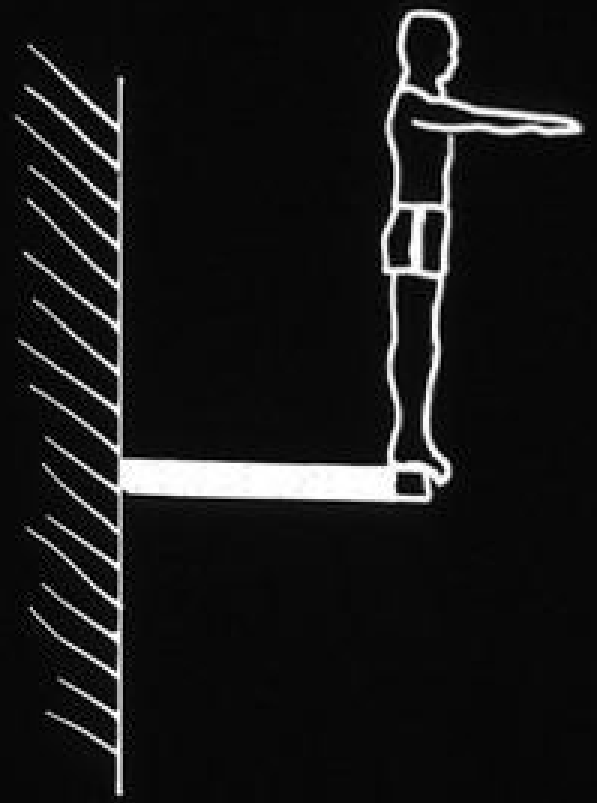


Complications associated with the halo-vest

A review of 245 cases

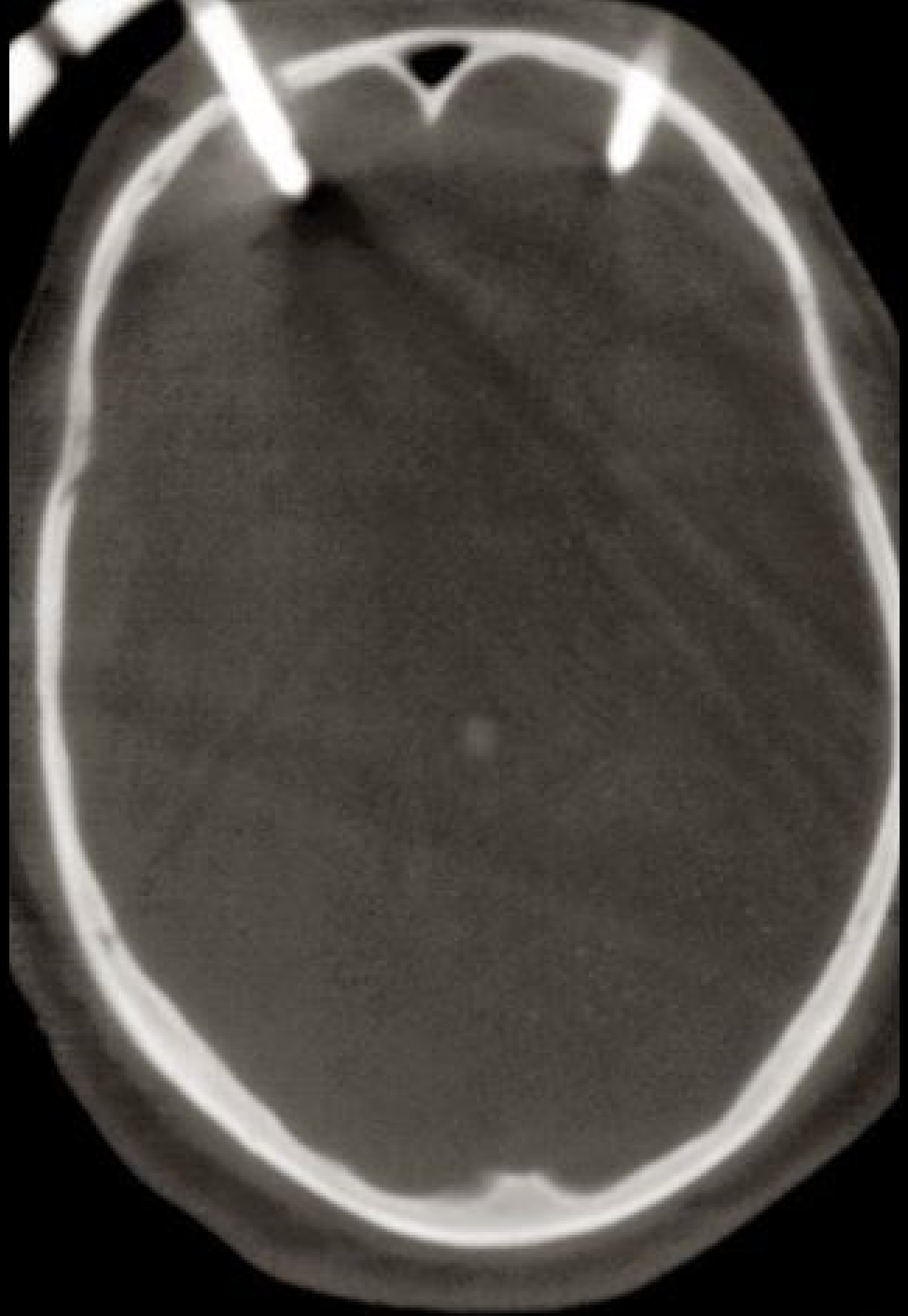
JOHN A. GLASER, M.D., RICHARD WHITEHILL, M.D., WARREN G. STAMP, M.D., AND JOHN A. JANE, M.D., PH.D.

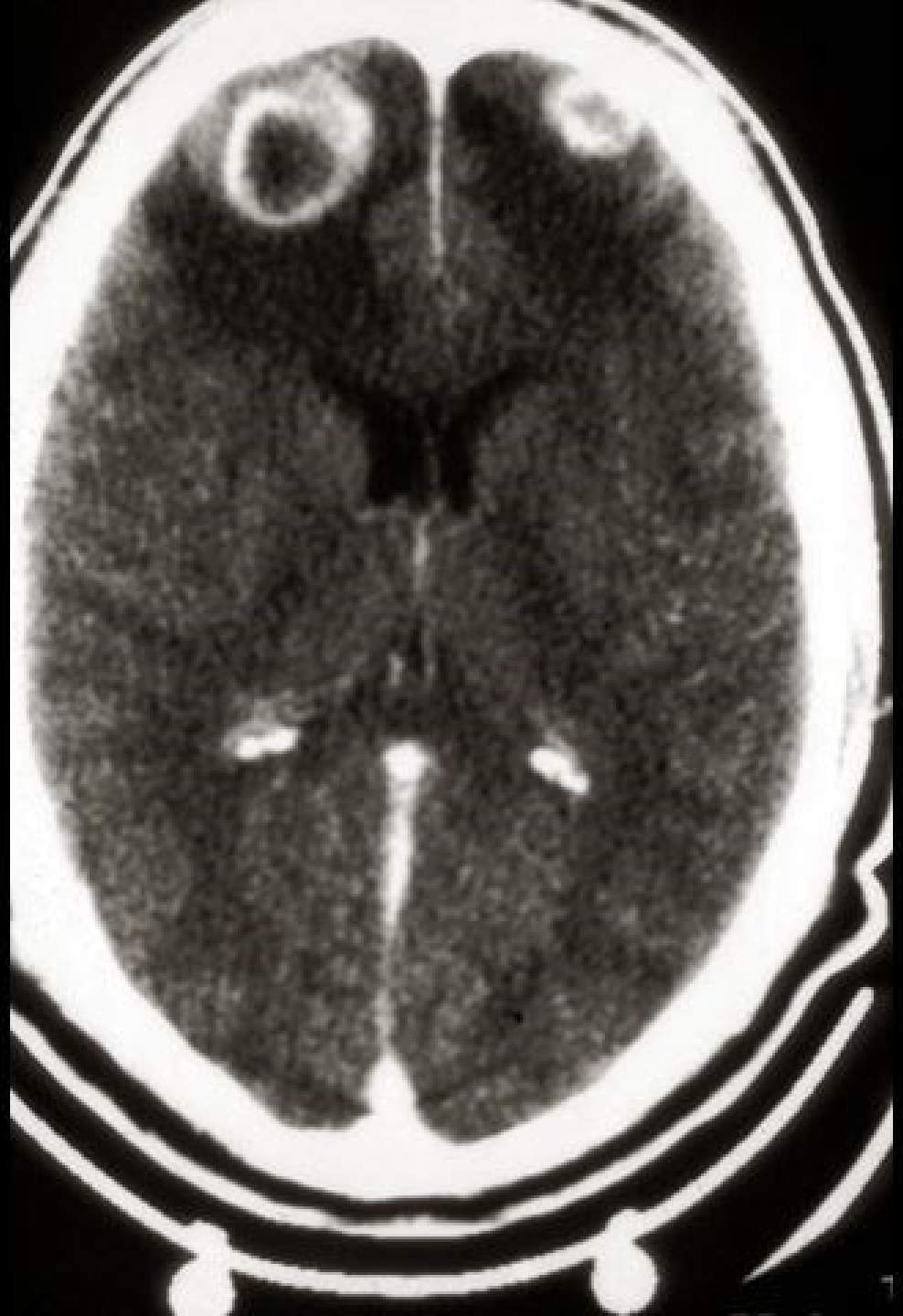
Departments of Orthopaedic Surgery and Rehabilitation and Neurological Surgery, University of Virginia Medical Center, Charlottesville, Virginia

✓ The cases of all patients treated with halo-vests for cervical trauma at the University of Virginia since 1977 were analyzed retrospectively. A standardized chart and radiographic review protocol were used to identify complications associated with the use of the orthosis. Two hundred and forty-five patients satisfied the criteria for inclusion in the study. No patient developed or suffered progression of a neurological deficit while immobilized. Complications included: pneumonia causing death (one patient); loss of reduction or progression of the spinal deformity (23 patients); spinal instability following orthotic immobilization for 3 months (24 patients); pin-track infection (13 patients); migration of anteriorly placed iliac-strut grafts (two patients); cerebrospinal fluid leakage from a halo pinhole (one patient); and miscellaneous (seven patients).

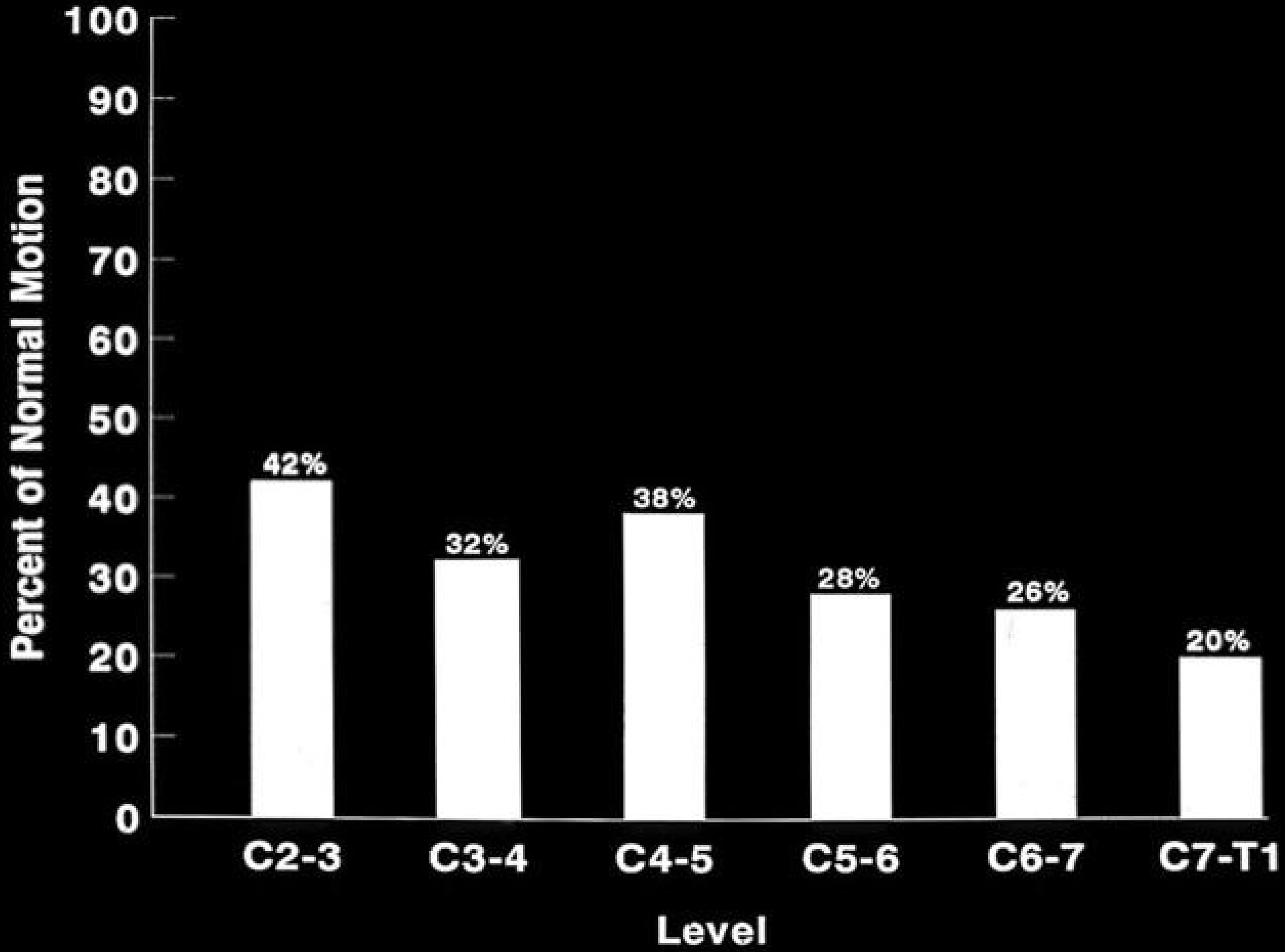
The findings indicate several conclusions. 1) The halo-vest protects patients with cervical instability from neurological injury. 2) It does not absolutely immobilize the cervical spine nor does it prevent progressive deformity of malpositioned strut grafts. 3) Even after a 3-month orthotic treatment period, surgery may be required on ligamentous and osseous injuries to provide spinal stability. 4) Elderly kyphotic patients may require custom-made vests. 5) A small subset of patients exists for whom the confining nature of the halo-vest is intolerable for 3 months.

KEY WORDS • **halo-vest** • **spine stabilization** • **immobilization**





UNTOWARD & UNEXPECTED STRESSES

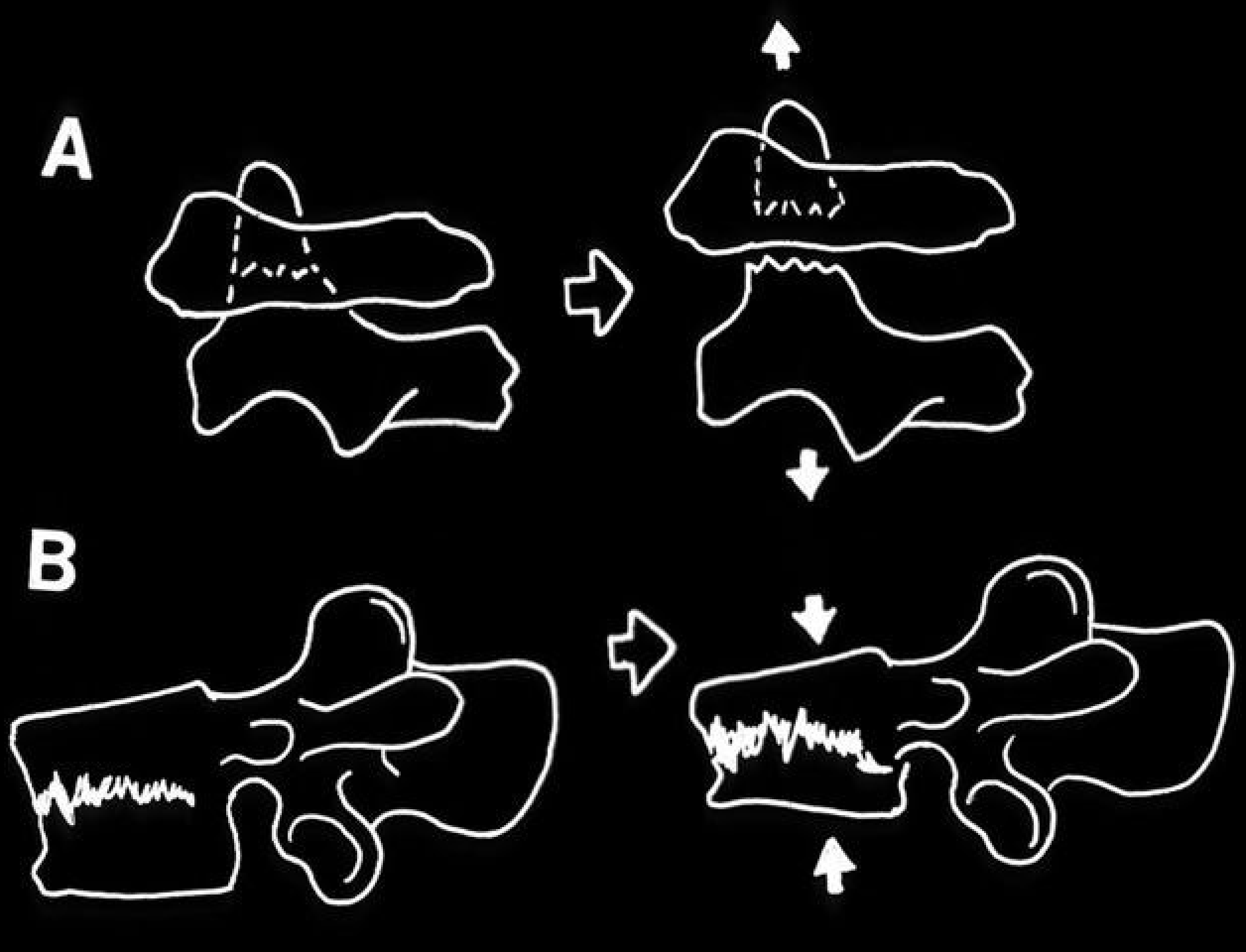

Percent of Normal Motion
100
90
80
70
60
50
40
30
20
10
0
42%
32%
38%
28%
26%
20%
C2-3
C3-4
C4-5
C5-6
C6-7
C7-T1
Level

MEAN DISTRACTION & COMPRESSION FORCES ON THE NECK IN A HALO VEST

POSITION	DISTRACTION (+) AND COMPRESSION (—) (±SD)
SITTING	4.4 ± 8.41
SUPINE	8.8 ± 3.96
SHOULDER SHRUG SITTING	14.5 ± 14.79
80° FORWARD TRUNK FLEXION SITTING	16.8 ± 9.01
IN TRANSFER SLING	17.8 ± 4.50
STANDING*	— 3
WALKING*	— 4

*ONE NEUROLOGICALLY INTACT PATIENT

SPINE 3:106, JUNE, 1978


A
B

Forces and Motions Across the Neck in Patients Treated with Halo-Vest

BENGT LIND, MD.* HANS SIHLBOM, MD.† and ANDERS NORDWALL, MD*

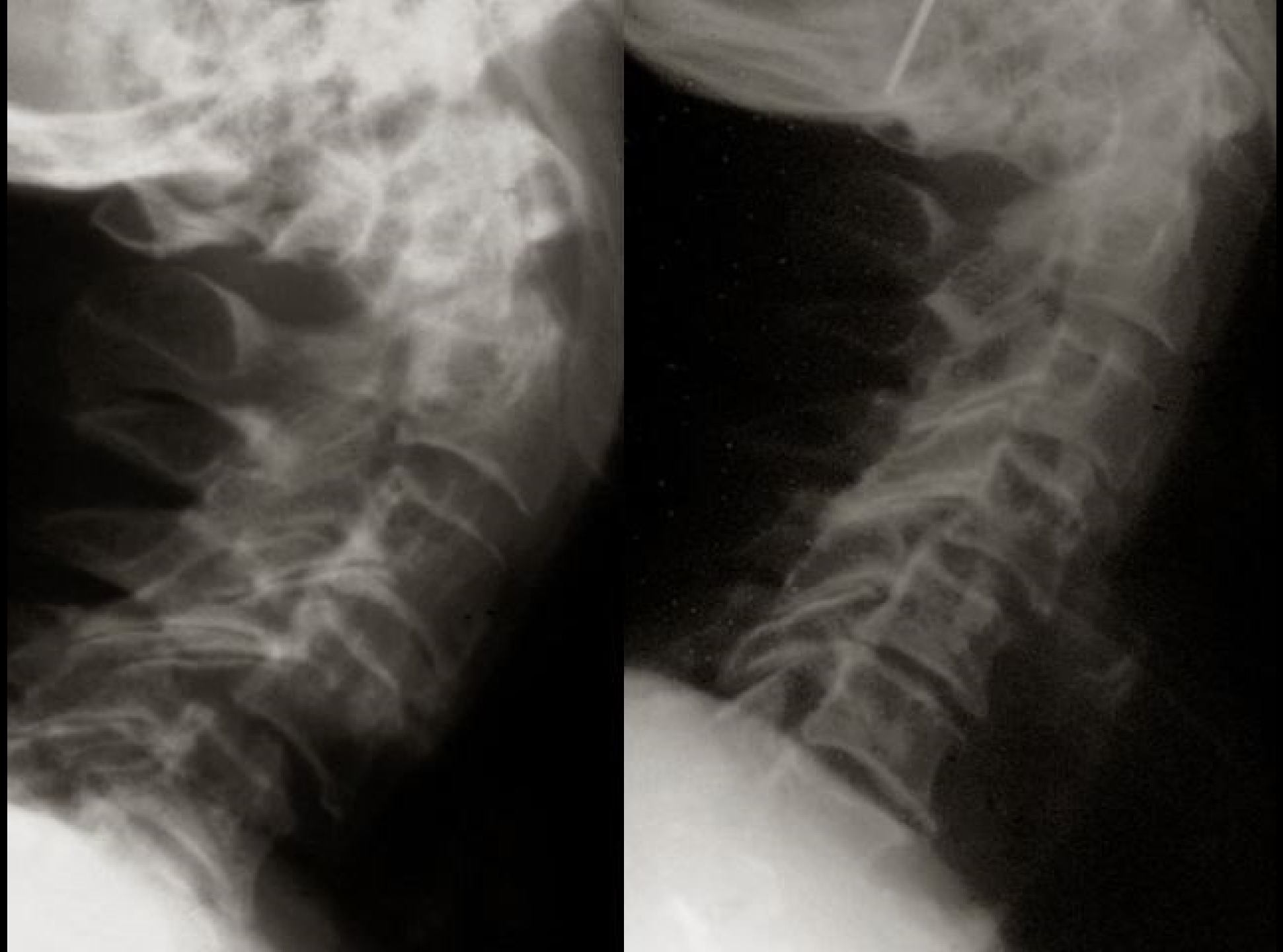


TABLE 2

*Average movement at each intervertebral level from maximum flexion to maximum extension**

Stabilization Device	O–C1	C1–2	C2–3	C3–4	C4–5	C5–6	C6–7	Sum of Angles	Average Movement at Each Level	Sum of Angles: O to C-6 or C-7	Measured Movement: O to C-6 or C-7
halo jacket	4.5 ± 2.7	1.3 ± 1.1	4.1 ± 2.6	4.1 ± 3.2	3.1 ± 2.6	3.0 ± 1.9	6.3 ± 5.7	23.4 ± 13.7	3.7 ± 3.1†	23.4 ± 13.7	5.2
Minerva jacket	3.5 ± 2.1	2.1 ± 1.1	1.7 ± 1.7	1.9 ± 1.2	2.0 ± 2.1	2.5 ± 1.6	2.3 ± 1.8	14.8 ± 4.4	2.3 ± 1.7†	14.8 ± 4.4	5.2

* Data are derived from Table 1, expressed in degrees as means ± standard deviations. O = occiput.

† Statistically significant difference ($p < 0.025$).

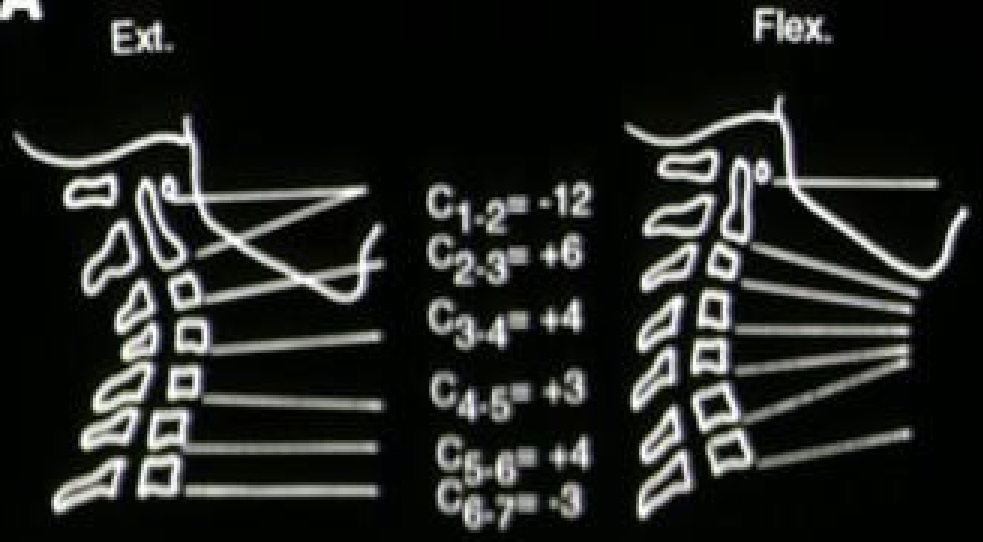
SNAKING = SUM OF MOVEMENTS - OVERALL MOVEMENT

COMPARISON OF HALO JACKET AND THE TMBJ

Average Movement (in degrees) at Each Intervertebral Level from Maximum Flexion to Maximum Extension

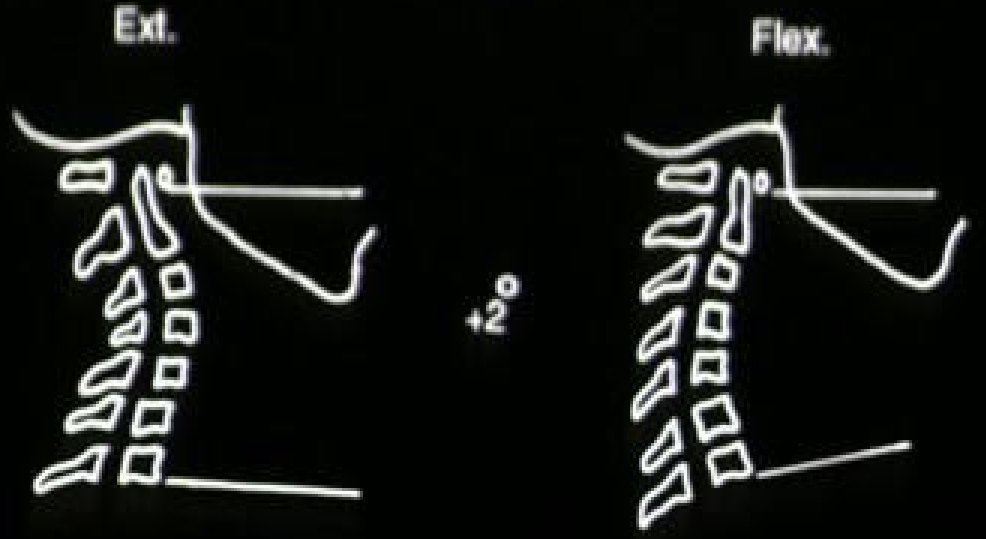
	Average Movement at Each Level	Sum of 0 to C6 or C7	Measured Movement Between Occiput and C6 or C7
HALO JACKET	3.7 ± 3.1	23 + 13.7	5.2
TMBJ	2.3 ± 1.7	14.8 + 4.4	5.2

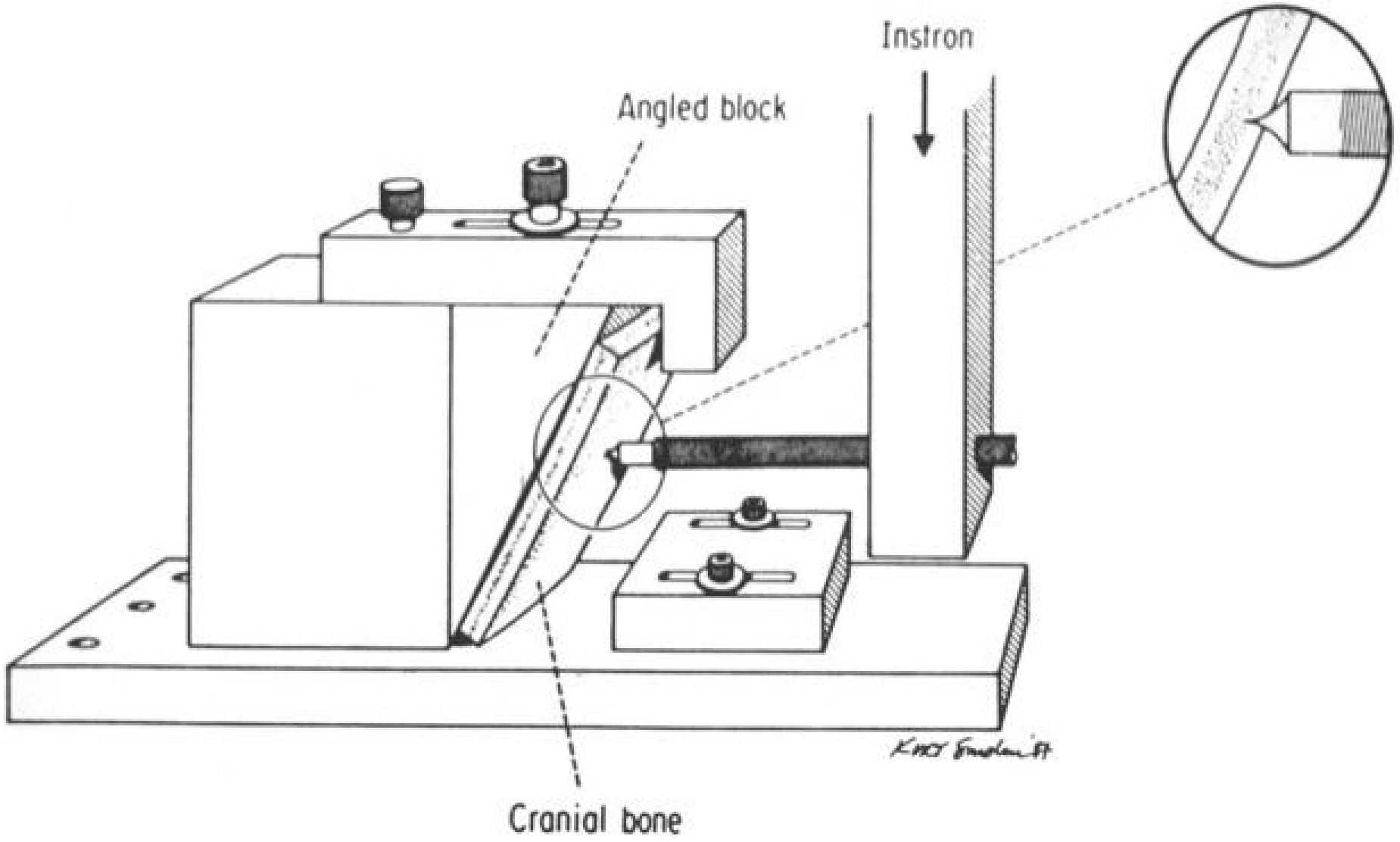
A



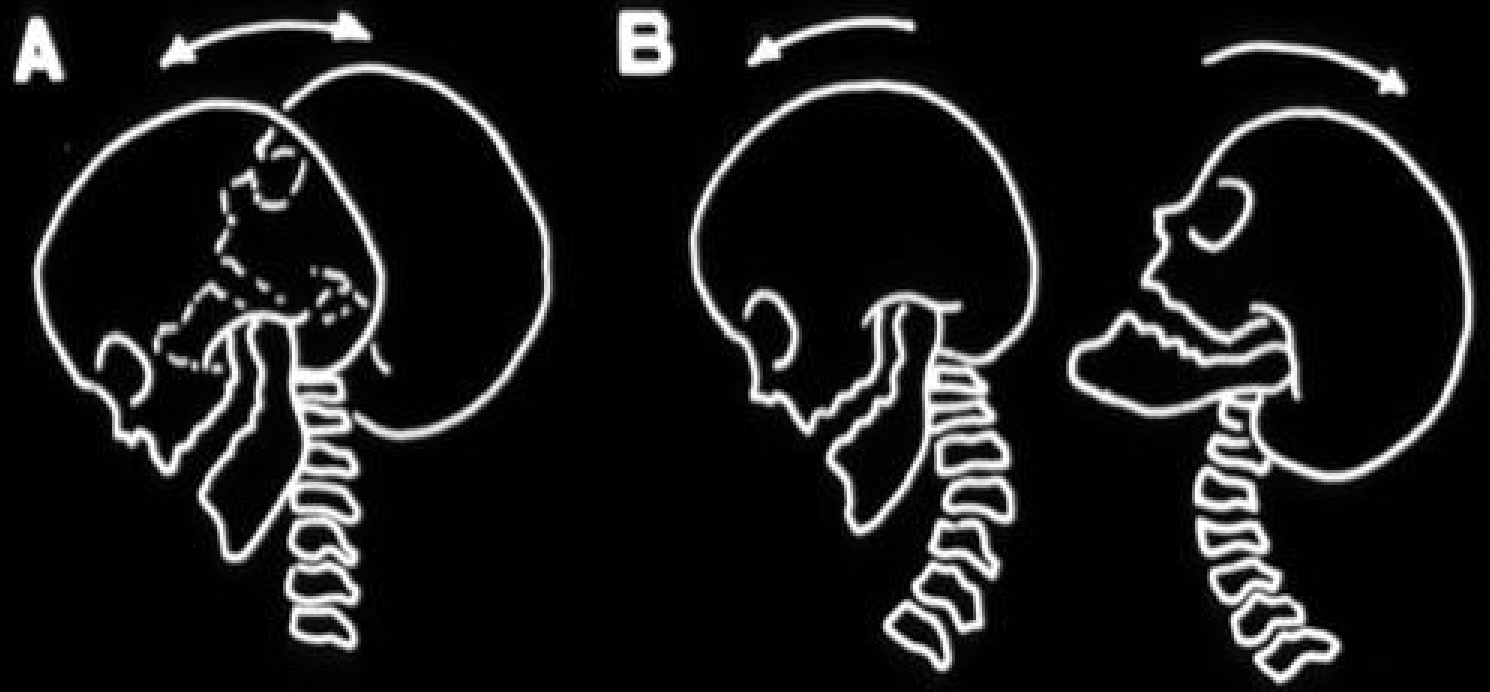
Sum of Absolute Values of Segmental Movements= 32°

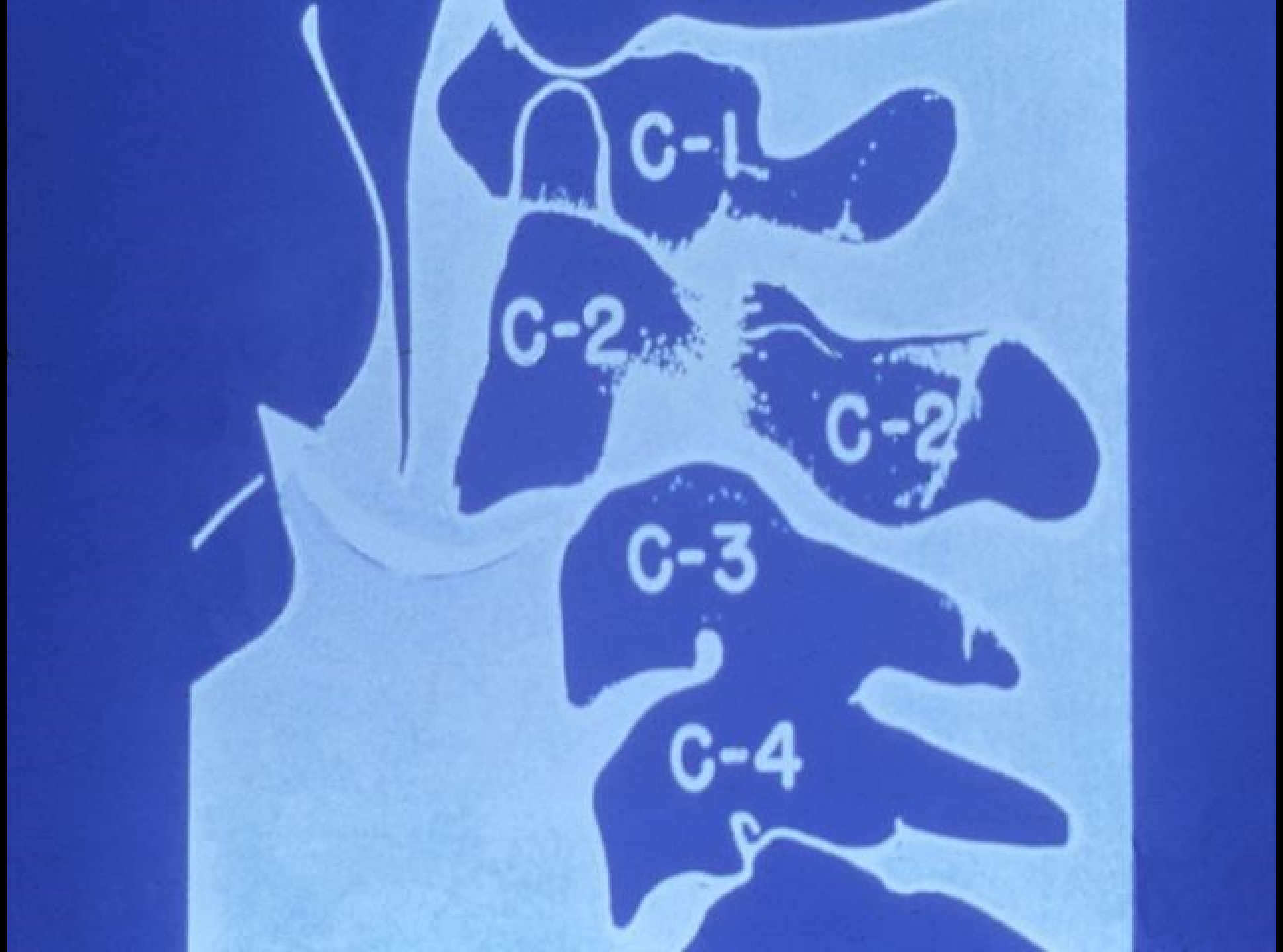
B

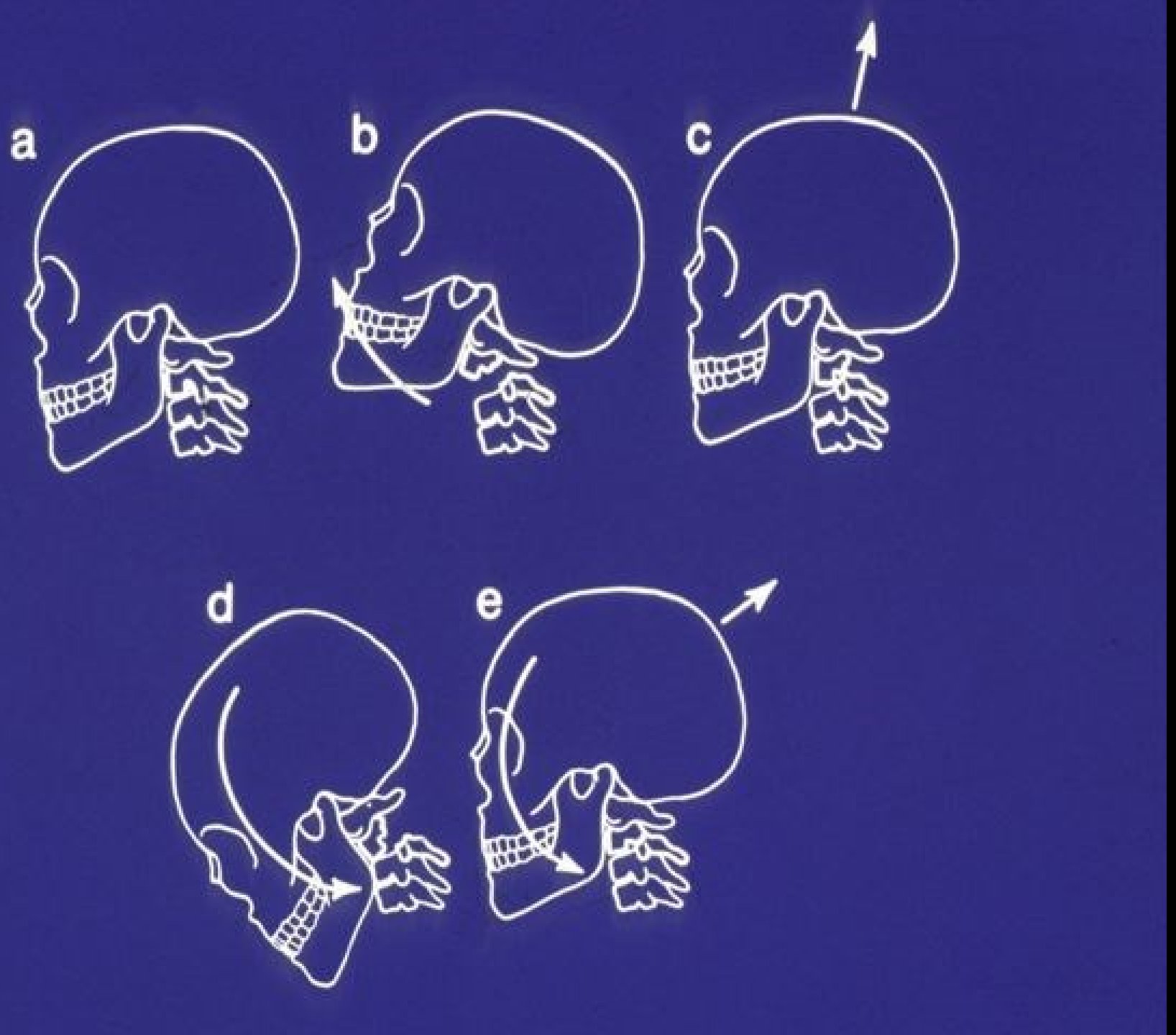


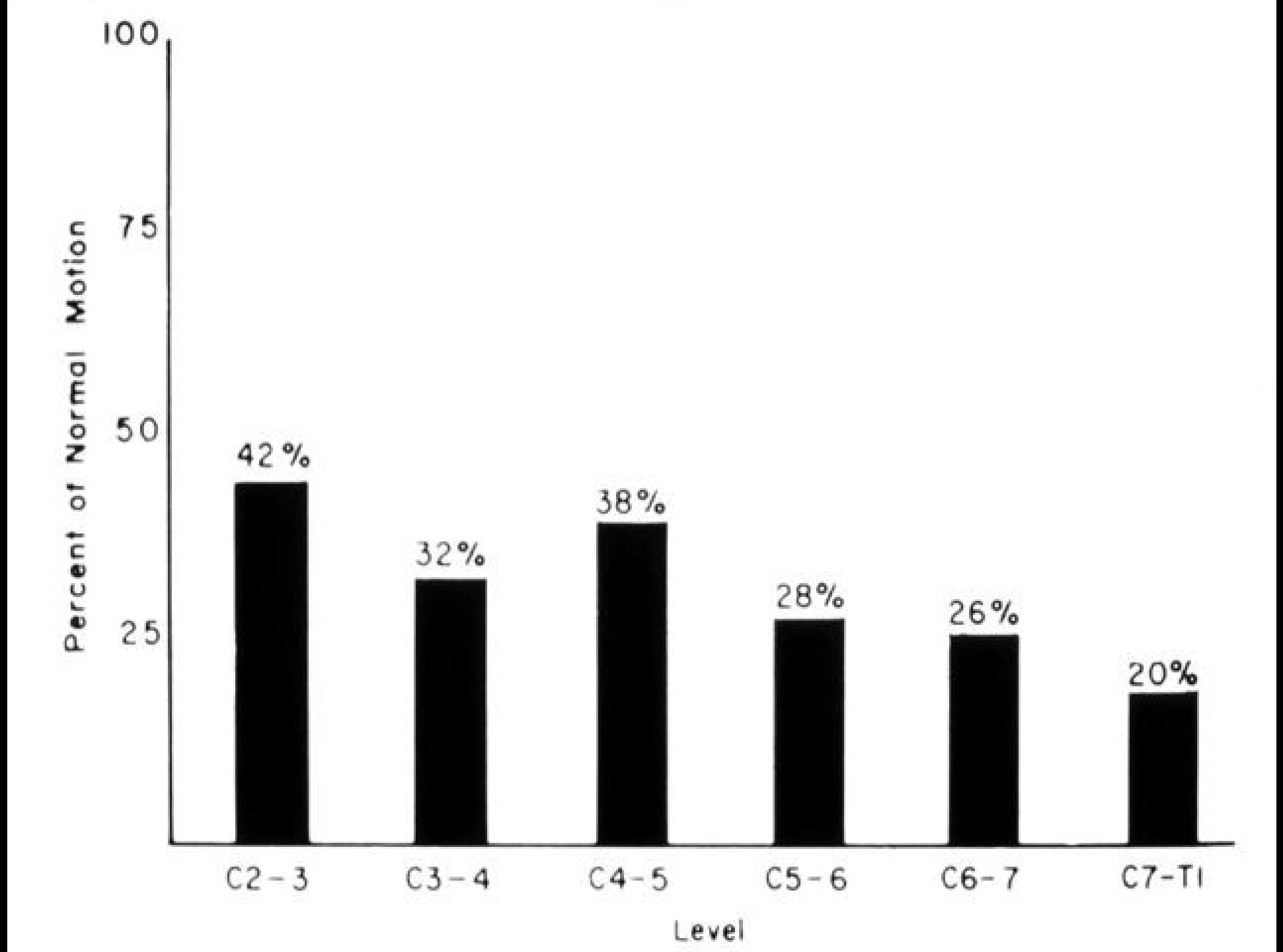

Instron
Angled block
Cranial bone

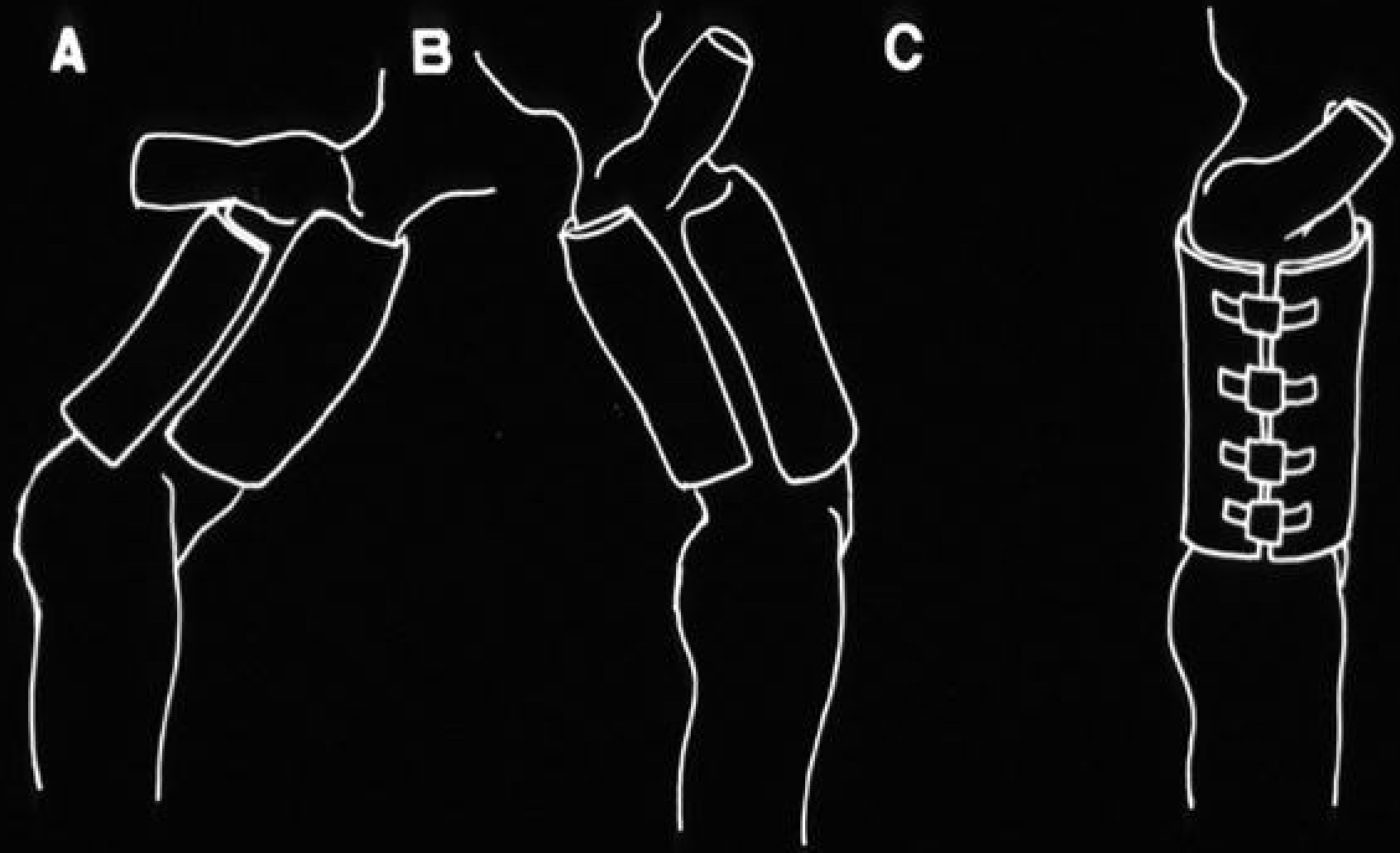
WHEN TO USE HALO?

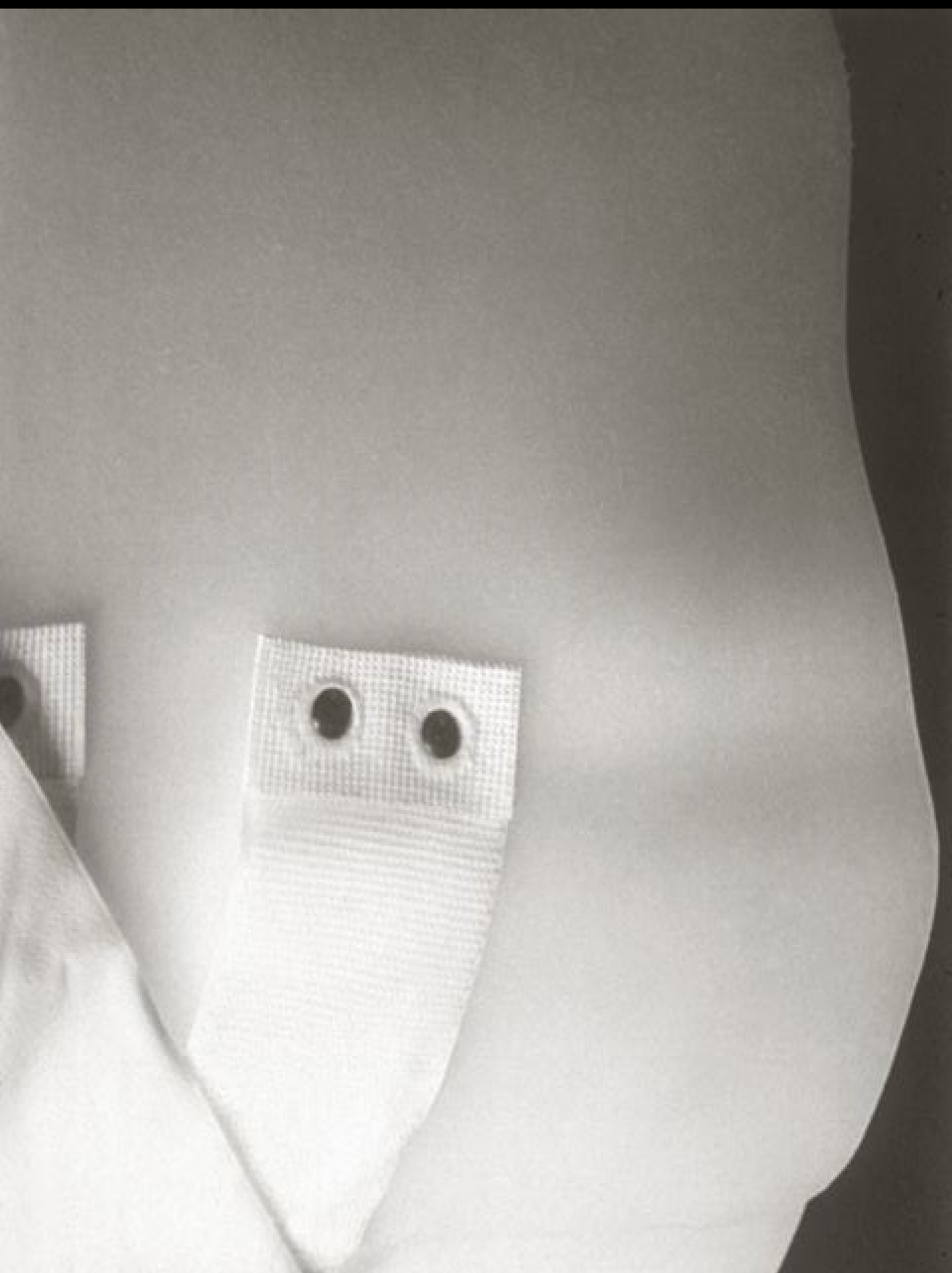

A
B


C-1
C-2
C-2
C-3
C-4


a
b
c
d
e


100
75
50
25
Percent of Normal Motion
42%
32%
38%
28%
26%
20%
C2-3
C3-4
C4-5
C5-6
C6-7
C7-T1
Level


A
B
C



HIP SPICA


DO NOT
EXPECT THE
UNREASONABLE

COMPLICATIONS

PAIN

PRESSURE

DEPENDENCE

HYGIENE

WEAKNESS AND ATROPHY

AGGRAVATION OF SYMPTOMS

VASCULAR

INEFFECTIVE STABILIZATION

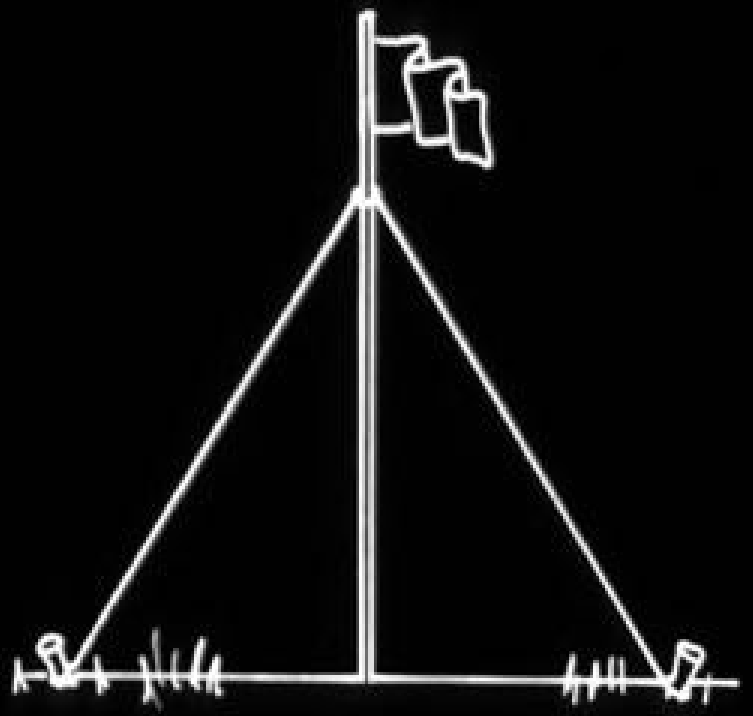
EXPECTATIONS

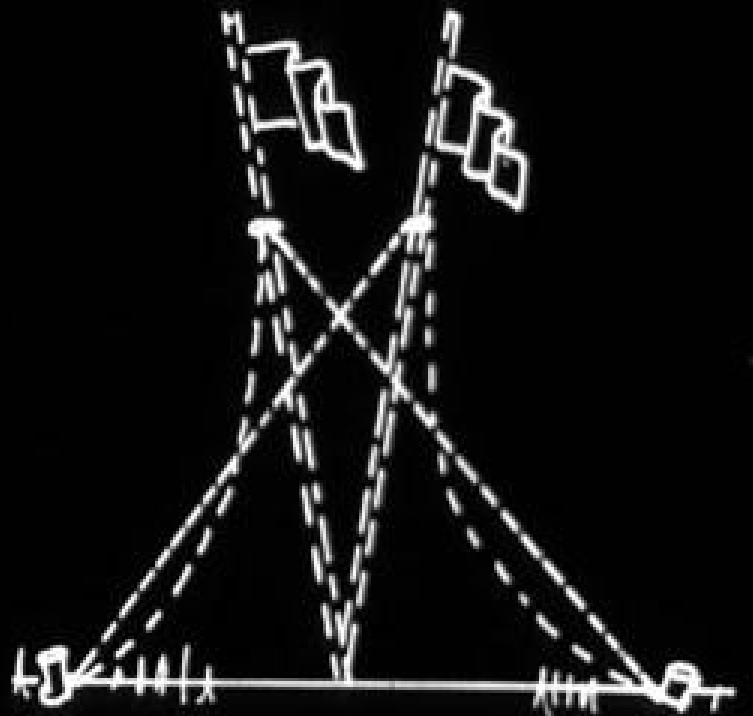
REMIND AND IRRITATE

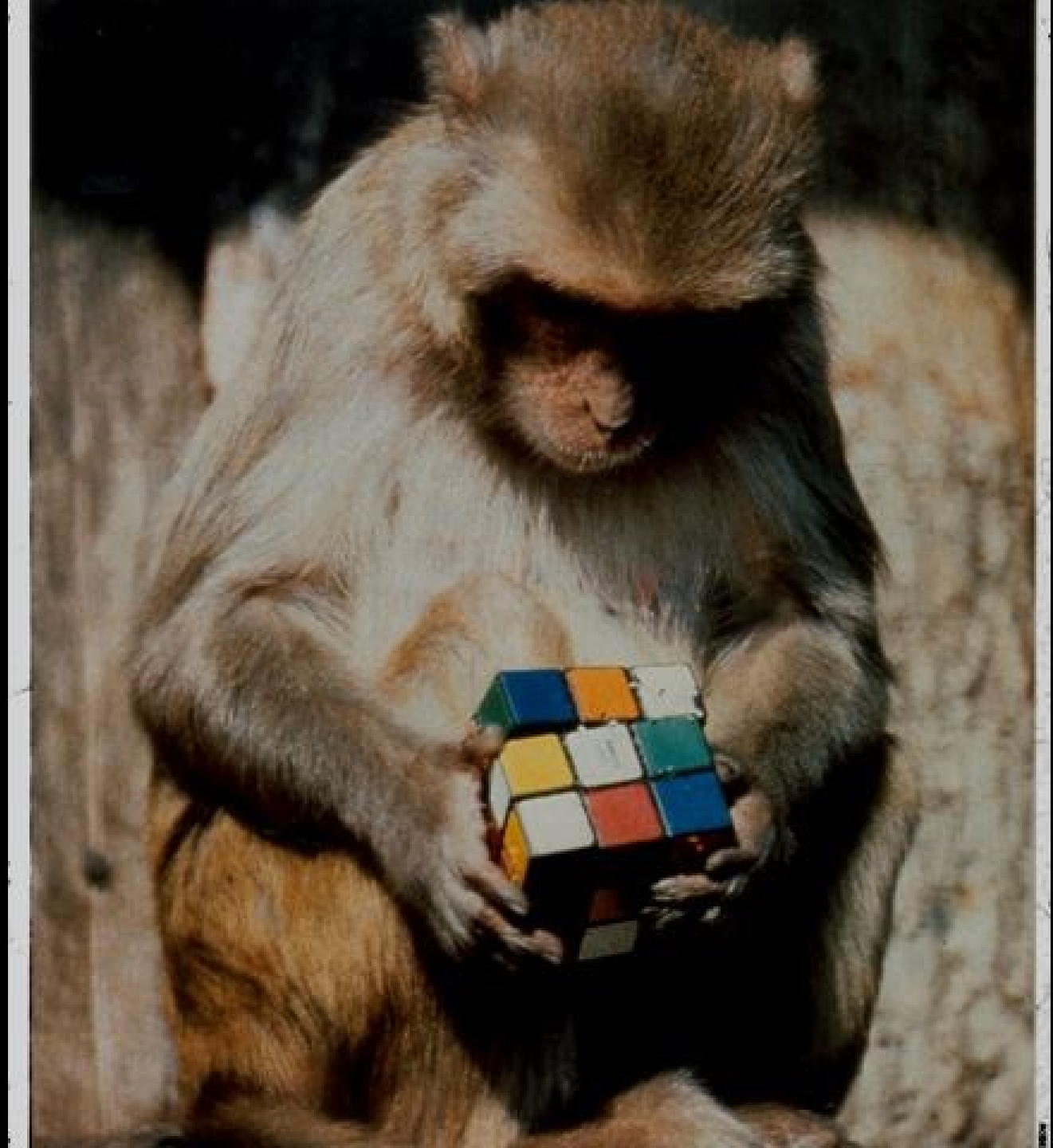
SUPPORT ABDOMEN

MOVEMENT RESTRICTIONS

REDUCE LORDOSIS





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Hands-On Fun

Cleveland Indians Baseball

The Hike

Crawfish Boil

Rock Hall Reception

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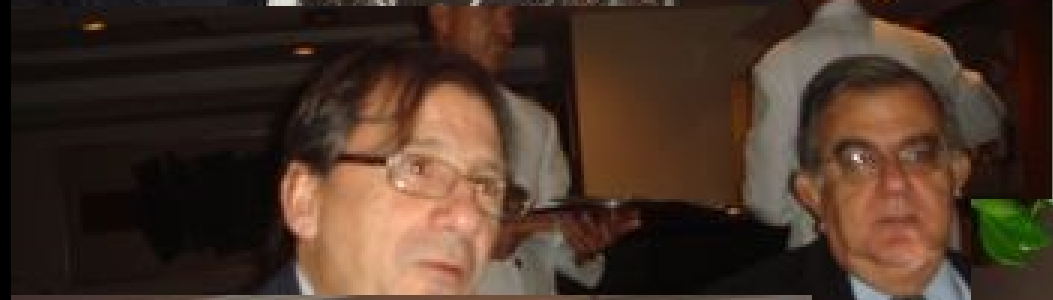
tobinm@ccf.org







THANK YOU!!!