

Point/Counterpoint: The Use of Deep Treatment Tables (>3ATA) for Treatment of DCI in Sport Divers

June 16, 2007

Moderator: J. Holm

Pro: R. Richard Smerz

Con: R. Moon

Participants

Richard William Smerz, D.O., MTM&H

Clinical Professor, Department of Surgery
University of Hawaii, John A. Burns School of Medicine
Medical Director, Hyperbaric Treatment Center

Richard E. Moon, MD, FRCPC, FACP, FCCP

Professor, Anesthesiology, Pulmonary and Critical Care Medicine
Duke University Medical Center

Overview

- Things are different in Hawaii
- “Hawaiian Deep Treatment Tables”
 - TT-280, TT-220, TT-160, TT-60
 - Air, 65/35, 50/50, Oxygen
- “Standard Tables”
 - USN Table 5 or 6

Reference

**Hawaiian Deep Treatments:
Efficacy and Outcomes, 1983-
2003**

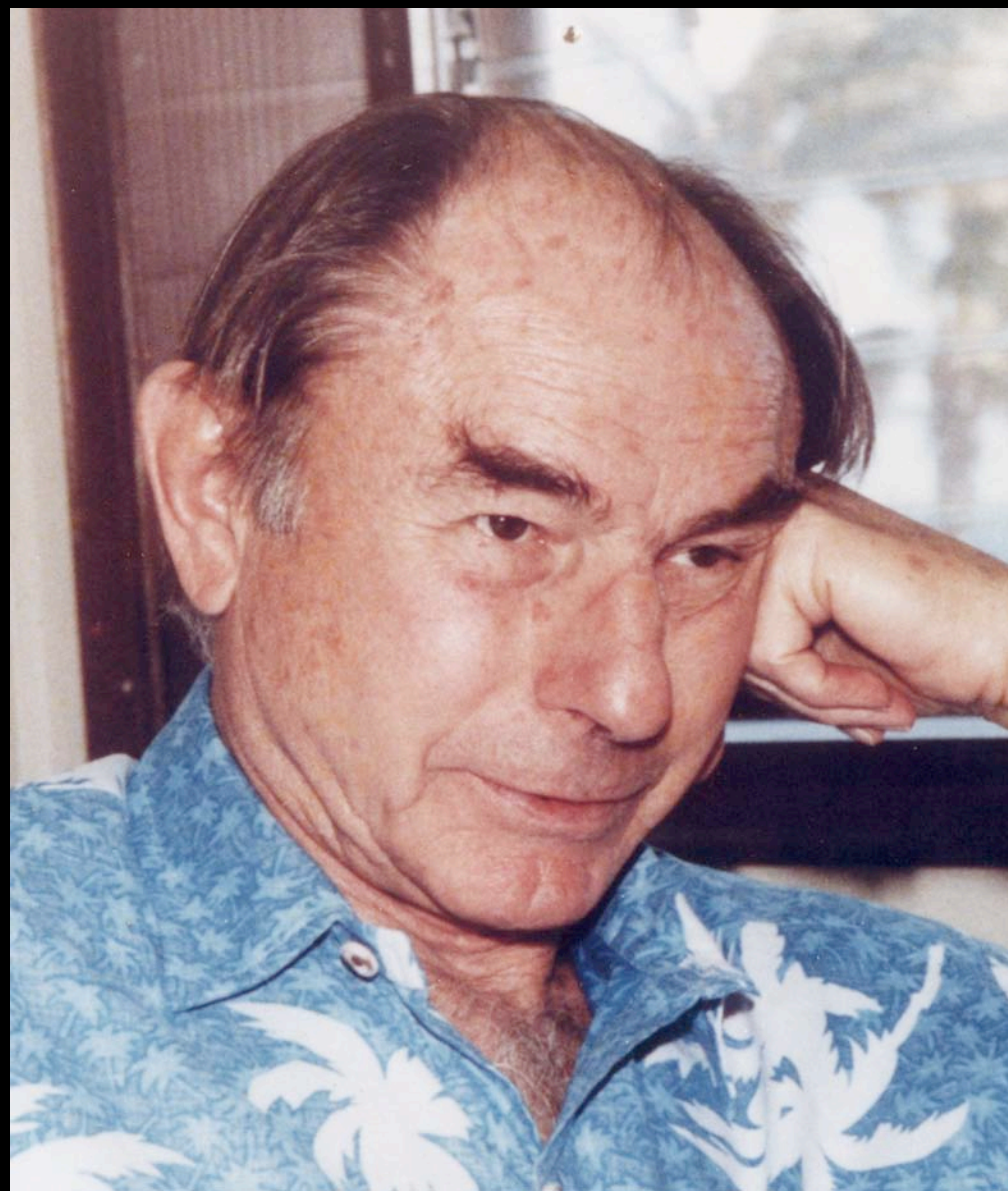
**UHM 2005, Vol 32, No. 5
RW Smerz, RK Overlock, H
Nakayama**

Schedule

- Introduction: J. Holm 5 minutes
- Pro: R. Smerz 15 minutes
- Con: R. Moon 15 minutes
- Pro Rebuttal: R Smerz 5 minutes
- Con rebuttal: R Moon 5 minutes
- Q & A: 10 minutes





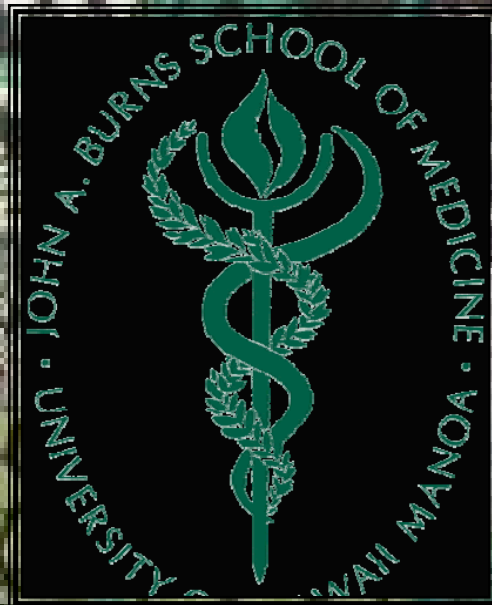


Dr. EL Beckman

The Case for Employment of the “Hawaiian Deep Tables” For Treatment of DCI in Non-military/Commercial Divers

Richard W Smerz, DO, MTM&H

Clinical Professor, Undersea and Hyperbaric Medicine
University of Hawaii, John A. Burns School of Medicine

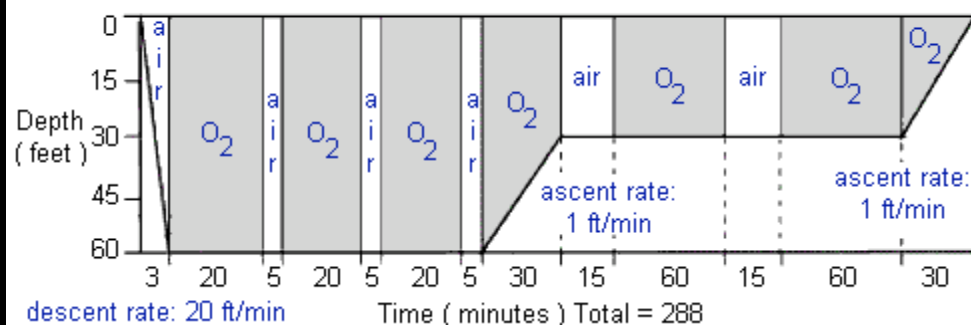




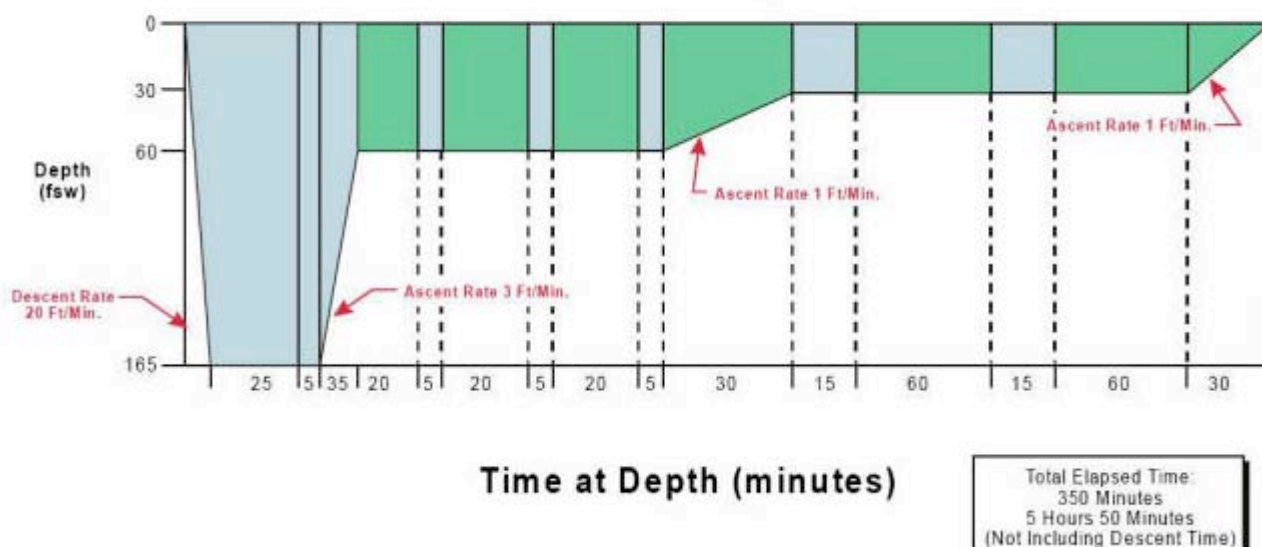
“The only new things we learn is the history we don’t know”

~ Harry Truman

US Navy Decompression Treatment Table 6



Treatment Table 6A Depth/Time Profile



USN O2 Treatment Table Studies 1968-80

<u>Investigator (yr)</u>	<u>#cases (type)</u>	<u>Delay to tx</u>	<u>Outcomes</u>
Workman (68)	150(110m;40c)	m=72%<2hrs c=17%<2hrs	85%-90% CR All residuals in civilians
Pearson/Leitch (72)	28(m)		71% CR
Erde/Edmonds (75)	106(c)	<24hrs ok >24hrs no good	81%CR overall 10% CR
Davis (77)	136(m)	<2hrs	99%CR
Bayne (78)	50(m)	92%<2hrs	98%CR
Yap (80)	58(c)	Mean=48hrs	50%CR

CR = complete recovery

USN O2 Treatment Table Experience Hawaii, 1970-1980

255 cases

81% (c), 19% (m)

Type I DCS = 41%

Type II DCS = 59%

Serious cases = 49%

Average delay to treatment = 6.6 hours

All treated on USN O2 tables

Results:

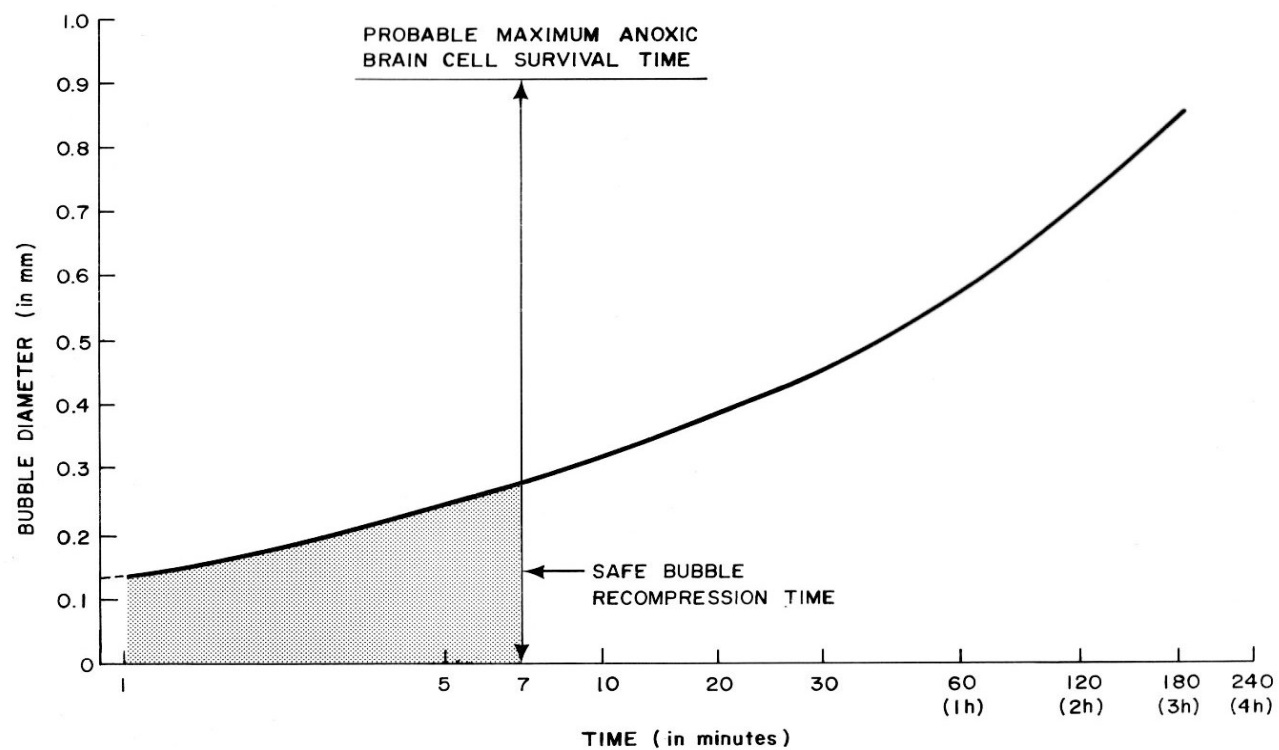
59% of all cases achieved full recovery

60% of Type I cases achieved full recovery

48% of serious cases achieved full recovery

7% had no improvement at all

Rate of Bubble Growth in Agarose Gel
At 1.0 ATA Ambient Pressure

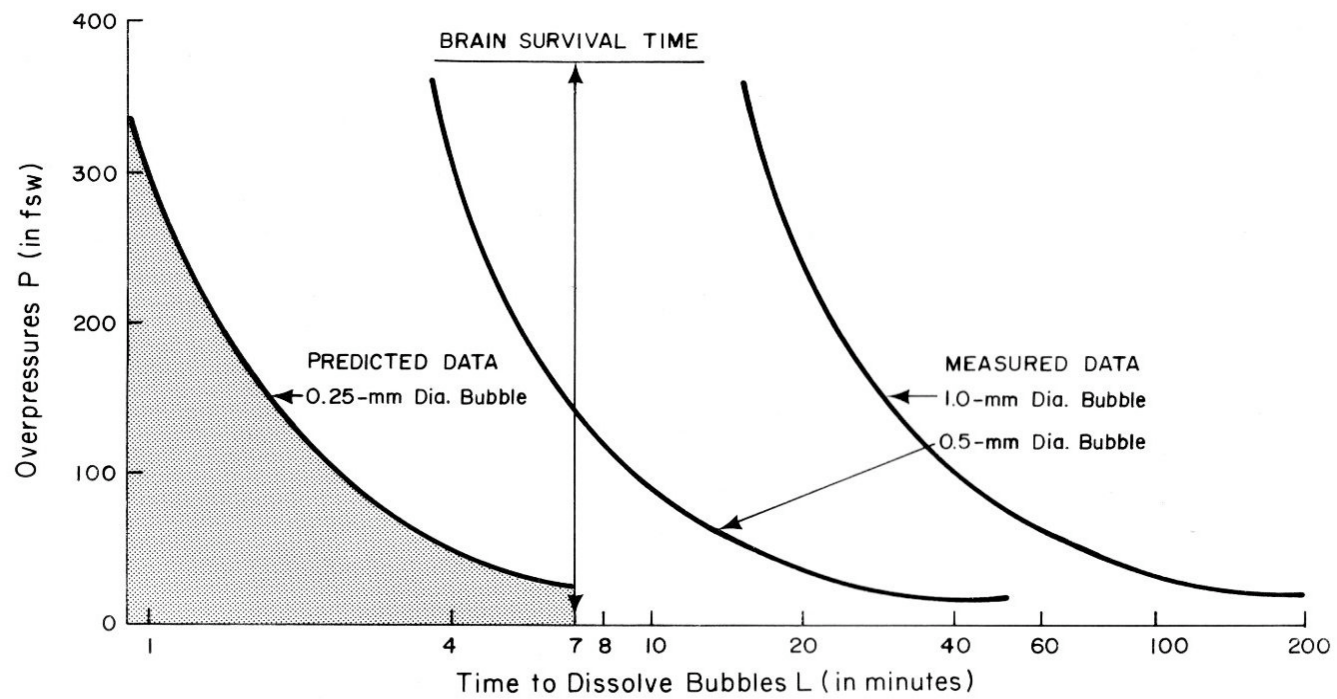


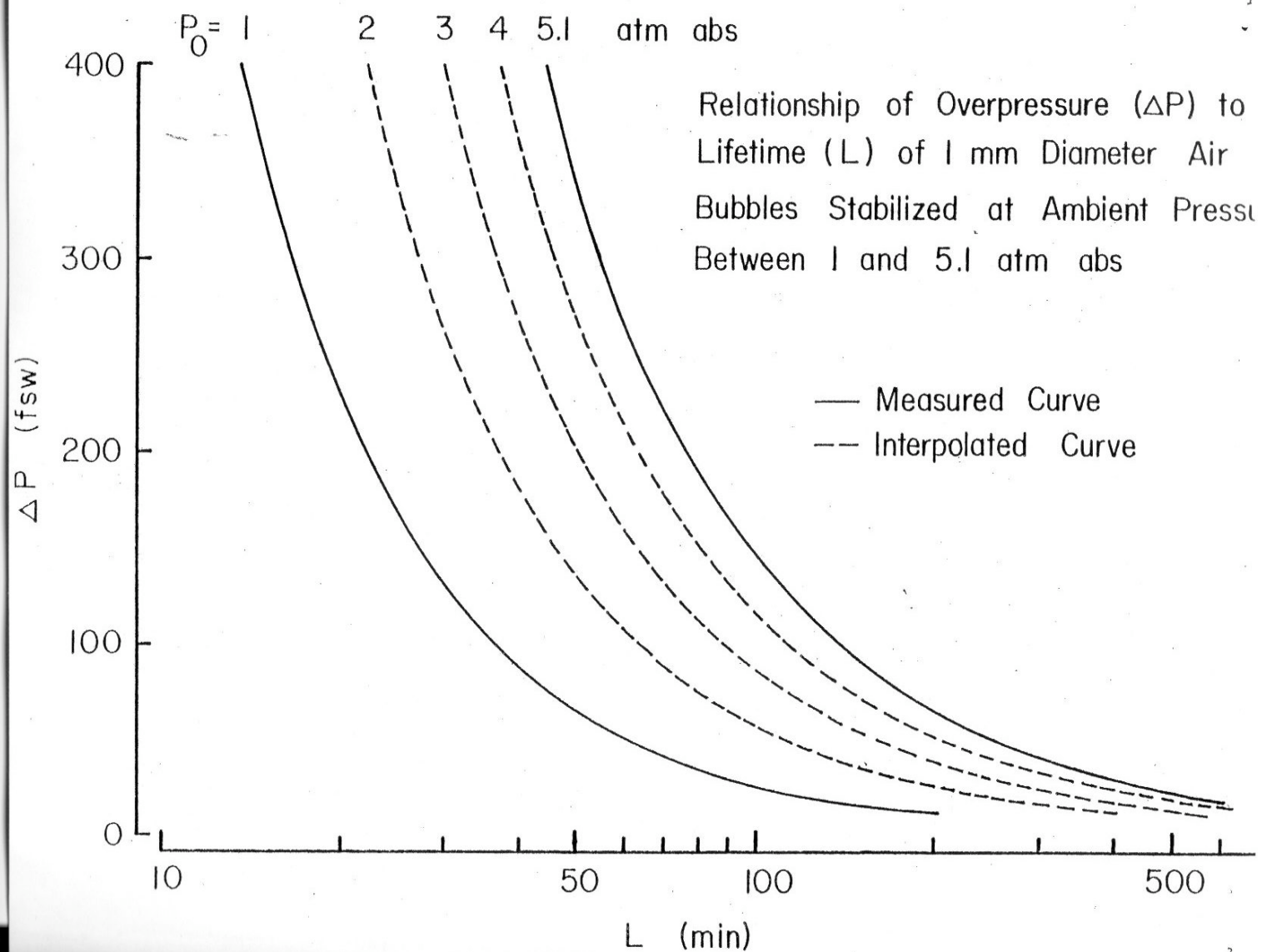


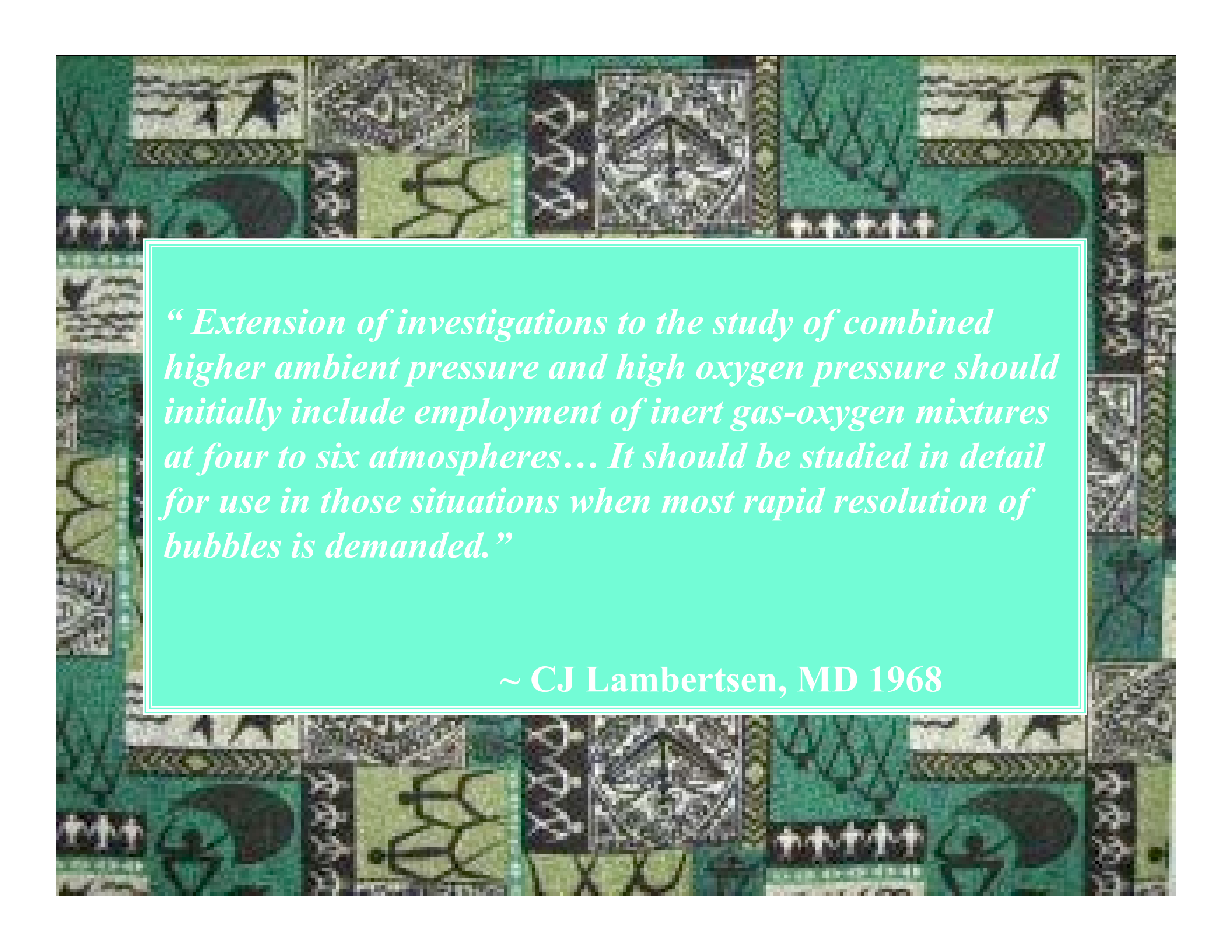
“Intuition is the source of scientific knowledge”

~ Aristotle

Curves to Show Time (L) Required to Dissolve
Bubbles of Graded Size After Application of Different Overpressures





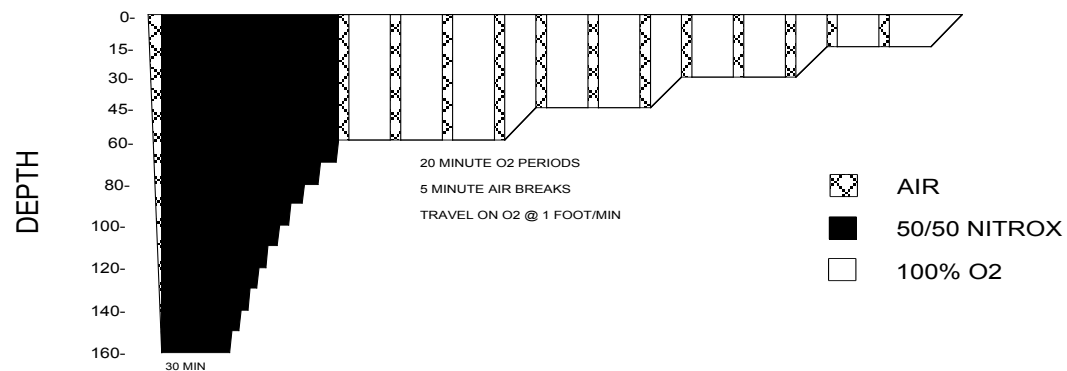


“ Extension of investigations to the study of combined higher ambient pressure and high oxygen pressure should initially include employment of inert gas-oxygen mixtures at four to six atmospheres... It should be studied in detail for use in those situations when most rapid resolution of bubbles is demanded.”

~ CJ Lambertsen, MD 1968

HTC 160 FSW TREATMENT TABLE

3/2/2/2

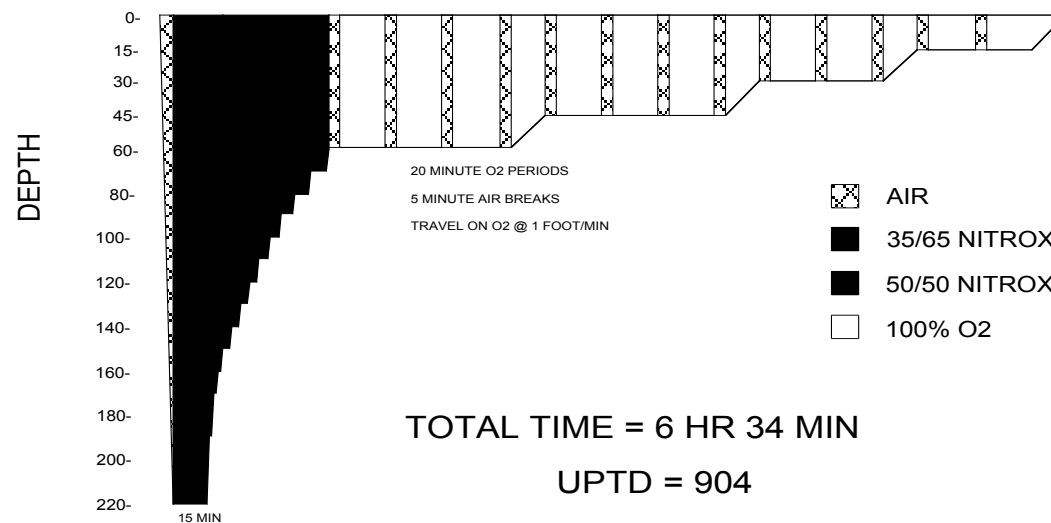


TOTAL TIME = 6 HR 18 MIN

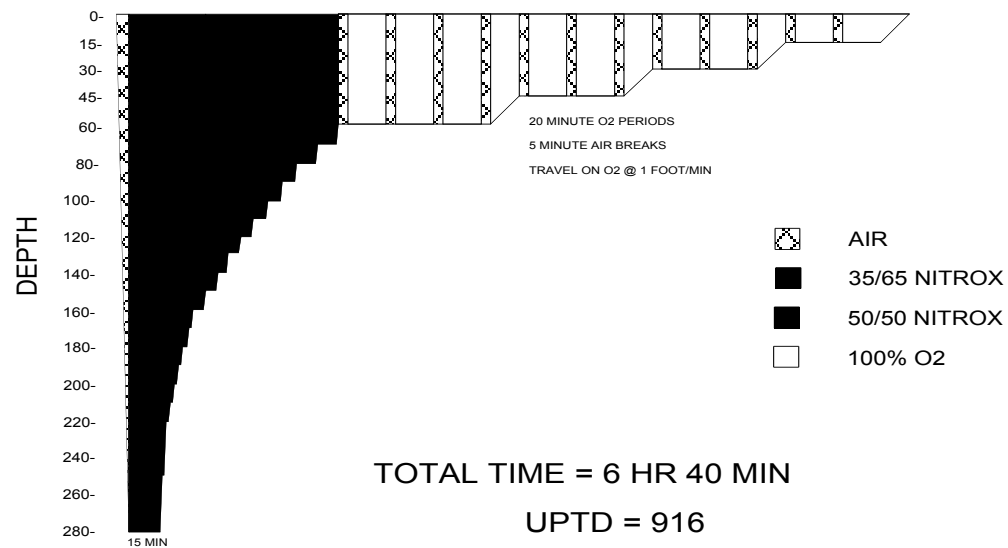
UPTD = 887

HTC 220 FSW DUAL NITROX TREATMENT TABLE

3/3/2/2



HTC 280 FSW DUAL NITROX TREATMENT TABLE



HTC Interim Reviews and Analyses

Adams, Beckman	UHMS ASM	1985
Arnold, Overlock	UHMS ASM	1989
Overlock, Arnold	UHMS Wksp	1990
Tolsma	UHMS ASM	1990
Overlock, et al	UHMS Wksp	1996
Overlock	UHMS ASM	2002



UHM 2005, Vol. 32, No. 5 - Hawaiian Deep Treatment Tables

Hawaiian Deep Treatments: Efficacy and Outcomes, 1983-2003

R W. SMERZ, R. K. OVERLOCK, H. NAKAYAMA

Hyperbaric Treatment Center, University of Hawaii, John A. Burns School of Medicine, Honolulu, Hawaii, 96817

USN O2 Treatment Table Studies 1984-2004

Investigator (yr)	#cases (type)	Delay to tx	Outcomes
Gray (84)	812 (m)		81%CR
Dick, Massey (85)	69 (c)	AGE=12hrs DCS=30hrs	67.6%CR 82.8%CR
Green, Tichenor, Curley (89)	208 (m)	Most<2hrs	96% (all Type I)CR
Pujante et al (90)	121	<6hrs=62%	Type I 93%CR Type II 71%CR
Van Hulst (90)	73(c)	<12hrs >24hrs	77%CR 43%CR
Kovacec et al (90)	95(c), 59(m)	<6hrs=34% 6-24hrs=36% >24hrs=30%	81%CR
Koch (90)	72(c)		77%CR
Bond, Moon, Morris(90)	327(c)		57.7%CR
Ball (93)	48(c) 1(m)	long delays	38.7%(all spinal)CR
DAN Annual Rpts 1994-2004	2500+ (c)	Average= 20-25hrs	70%-75%CR

CR = complete recovery

HTC Treatment Table Study 2005

(based on symptomatic cases treated 1983-2003)

Average delay to treatment after symptom development for all cases = 16hrs

At time of discharge:

All symptomatic cases treated (n=889):

92.9% achieved complete functional recovery

76.4% of severe cases achieved complete functional recovery

3.5% had no improvement

Average number of treatments/case= 2.1

Cases treated with a deep table (n=800)

91.6% achieved complete functional recovery

75.6% of severe cases achieved complete functional recovery

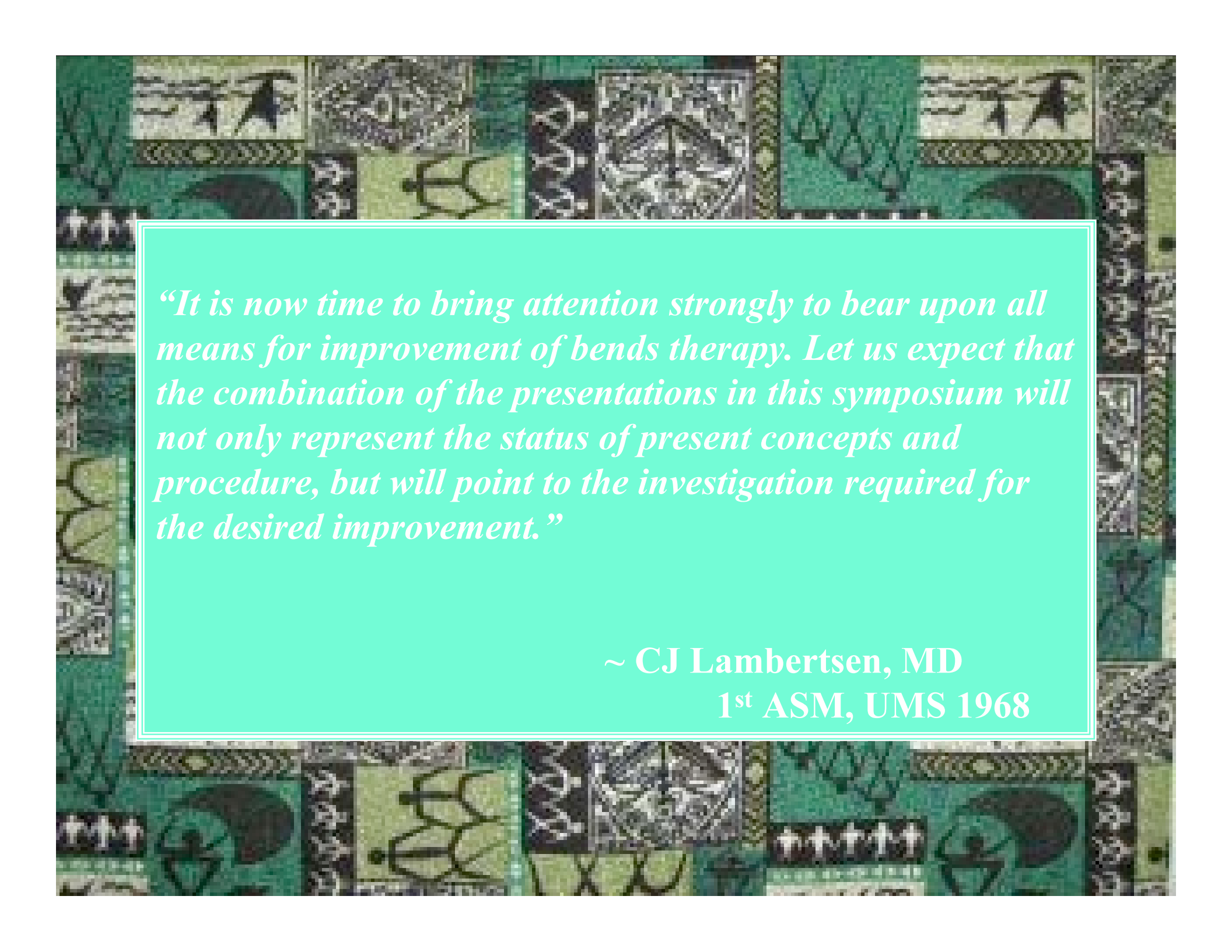
3.8% had no improvement

Average number of treatments/case= 2.3



*“Sometimes you have to crawl out on a limb
because that is where the fruit is.”*

~ Will Rogers



“It is now time to bring attention strongly to bear upon all means for improvement of bends therapy. Let us expect that the combination of the presentations in this symposium will not only represent the status of present concepts and procedure, but will point to the investigation required for the desired improvement.”

~ CJ Lambertsen, MD
1st ASM, UMS 1968



Deep Treatment Tables (>3 ATA) Have no Advantage over 2.8 ATA Tables for the Treatment of DCI in Sport Divers

Richard Moon, MD

**Depts. of Anesthesiology and Medicine
Duke University Medical Center
Divers Alert Network
Durham, North Carolina, USA**

Hypothesis

**For the treatment of decompression illness,
deep tables are more efficacious than
standard USN oxygen tables**

USN Tables 5 and 6

TABLE 5 DEPTH/TIME PROFILE

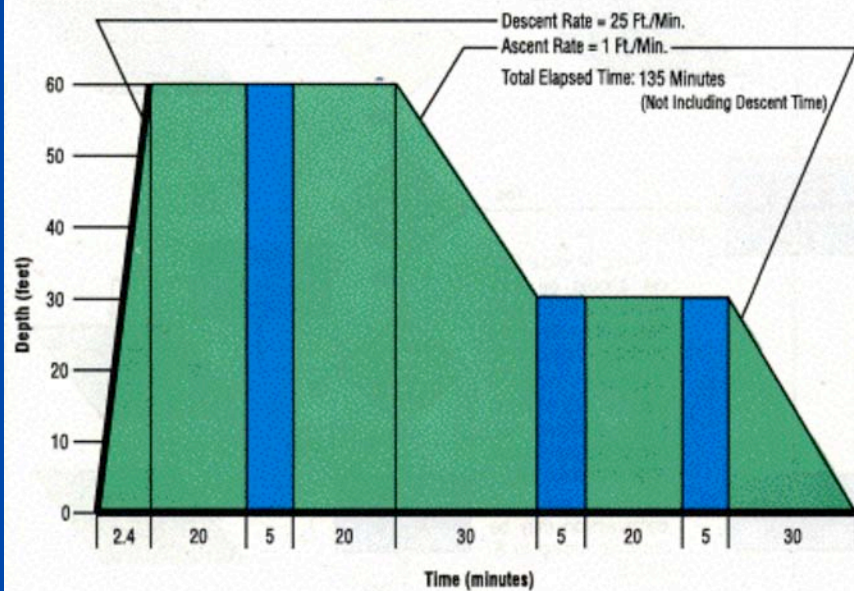
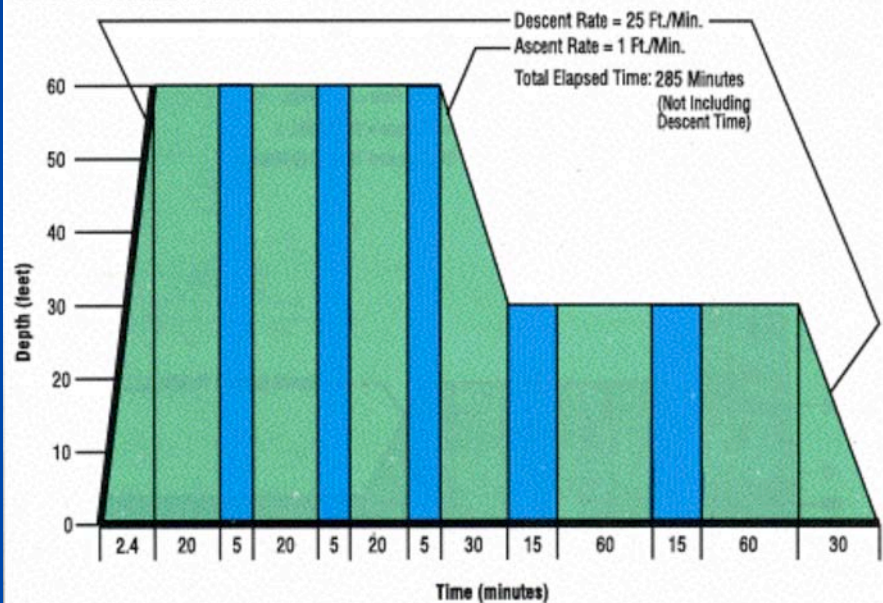


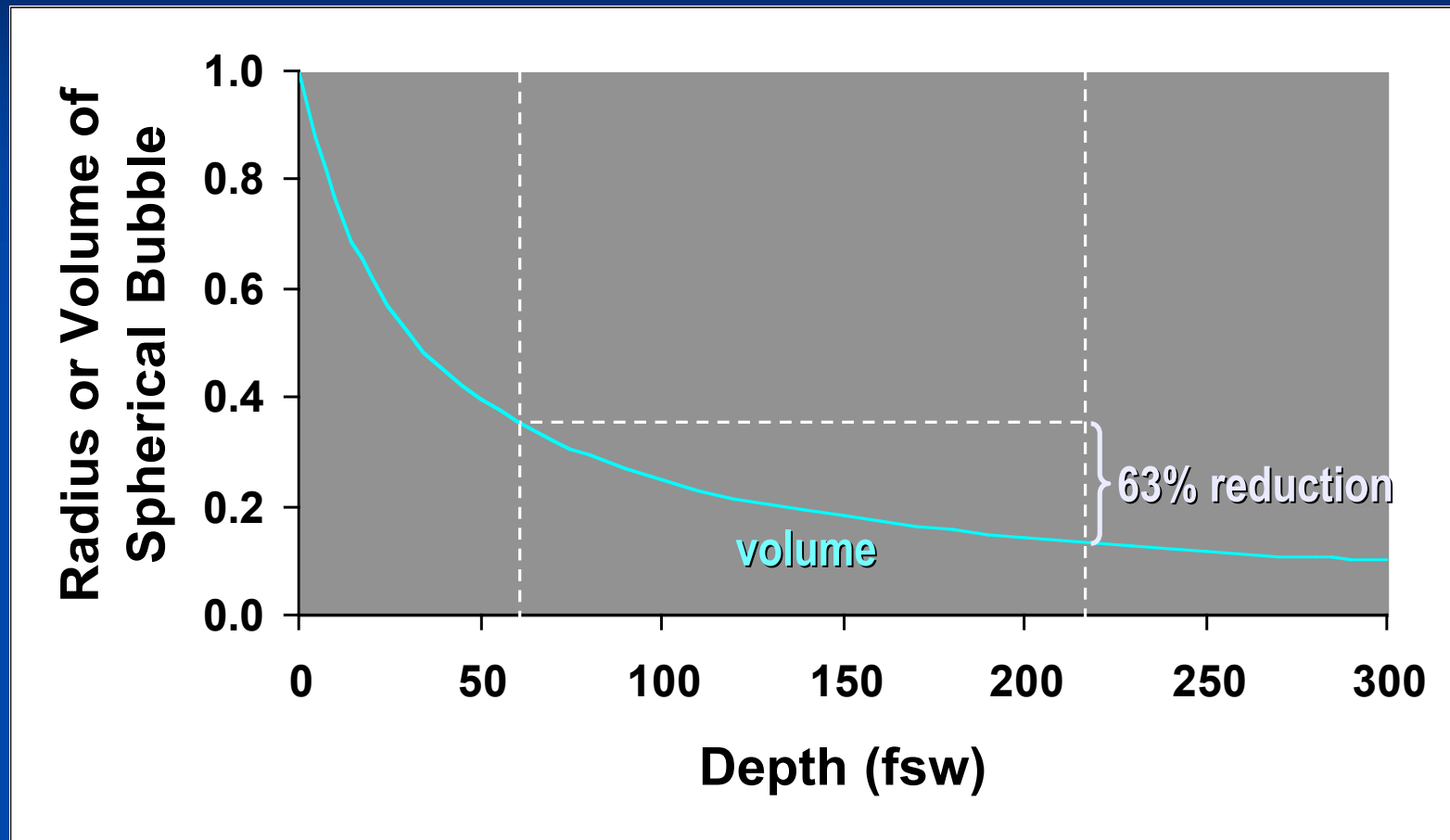
TABLE 6 DEPTH/TIME PROFILE



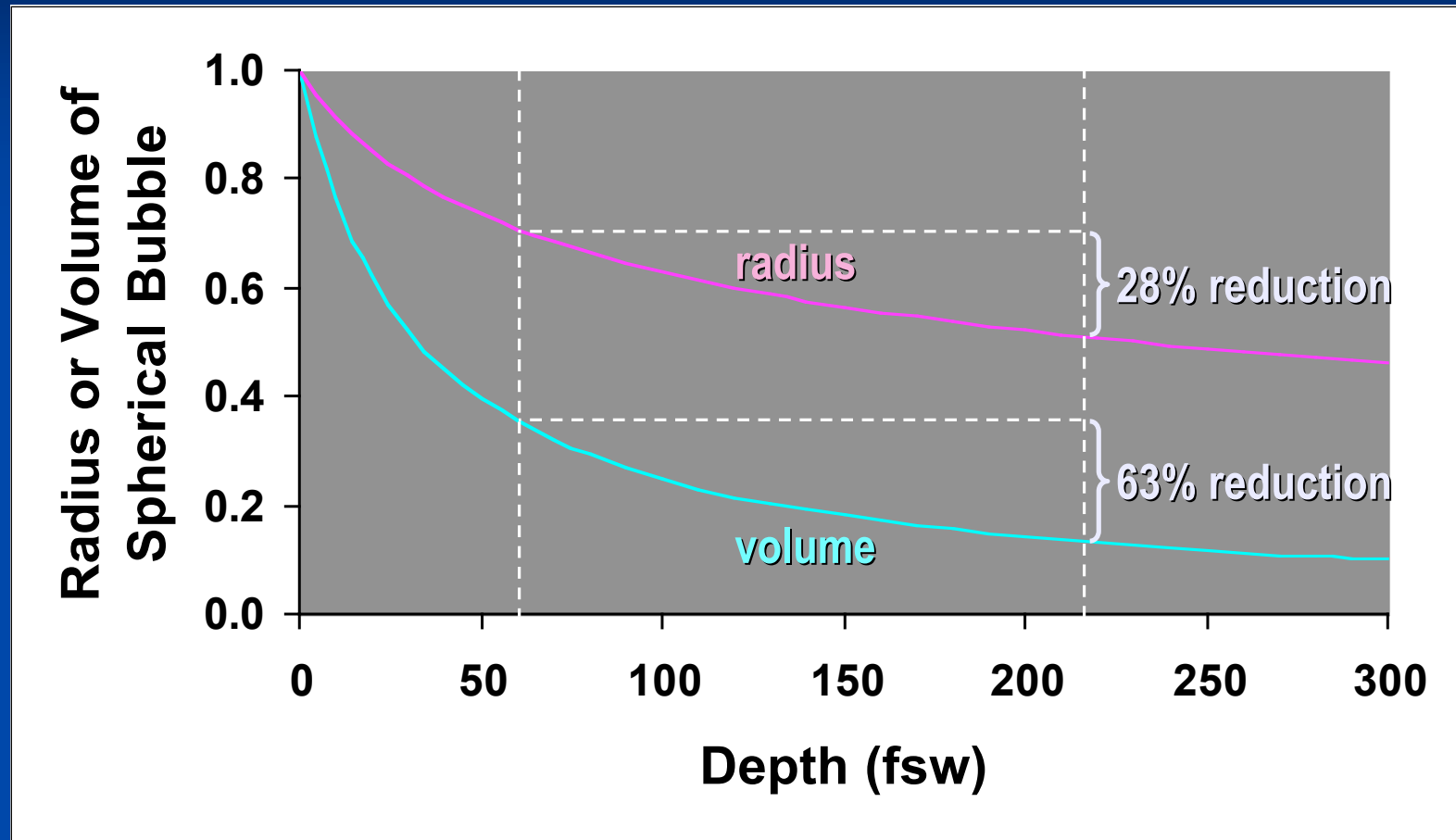
Strength of Evidence

- γ **Randomized controlled studies**
- γ **Prospective, controlled, non-randomized, cohort studies**
- γ **Comparison of case series with historical controls**
- γ **Case series**
- γ **Animal studies**
- γ **Plausible rationale**

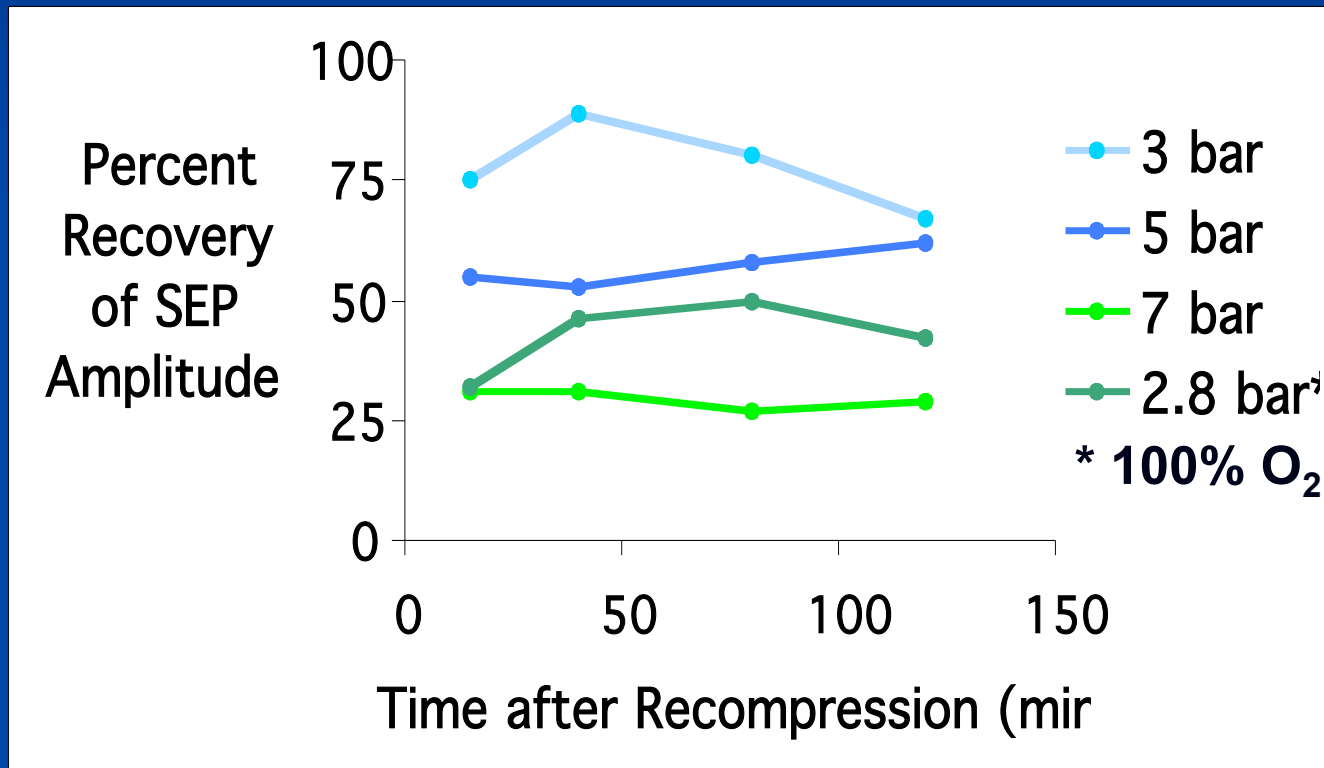
Boyle's Law



Boyle's Law

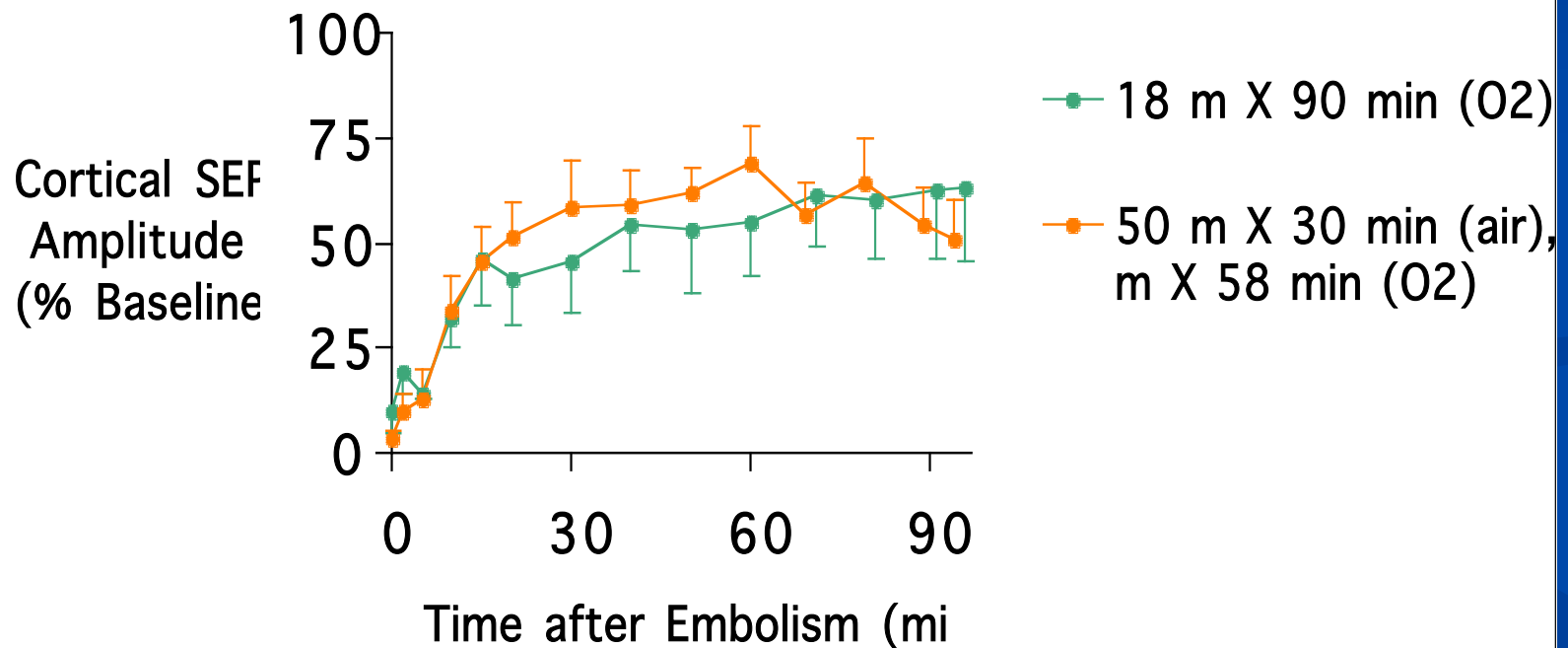


Effect of Pressure on Spinal Cord DCS (PO_2 2 bar)



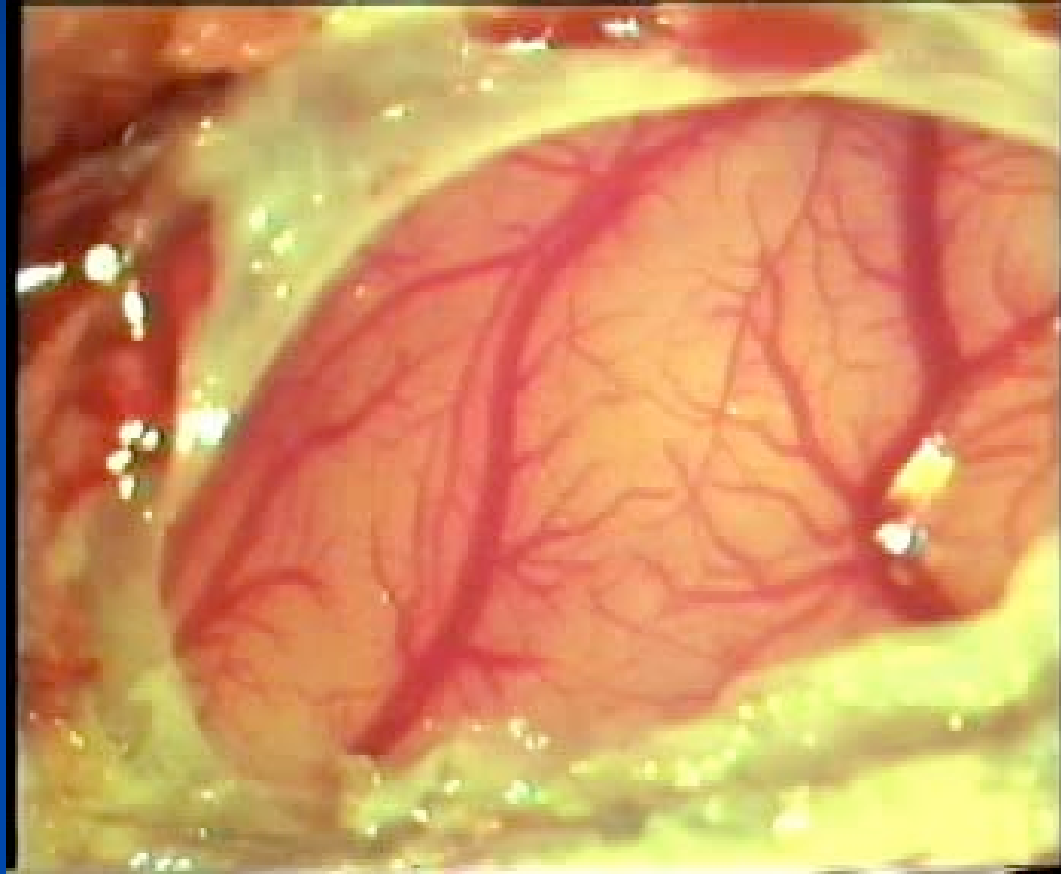
Leitch DR, Hallenbeck JM *Undersea Biomed Res* 12:291, 1985

Effect of Treatment Depth on AGE



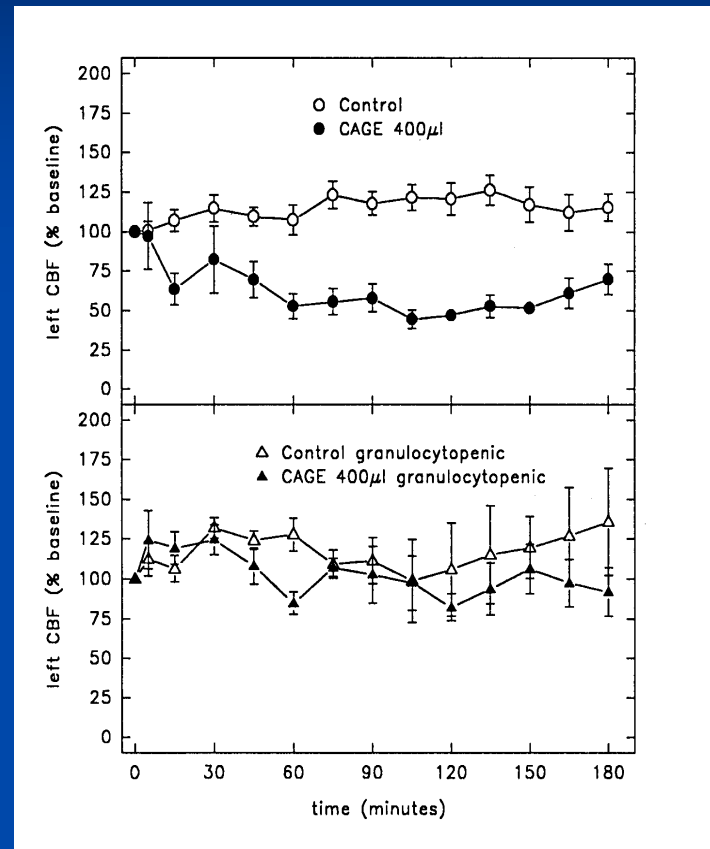
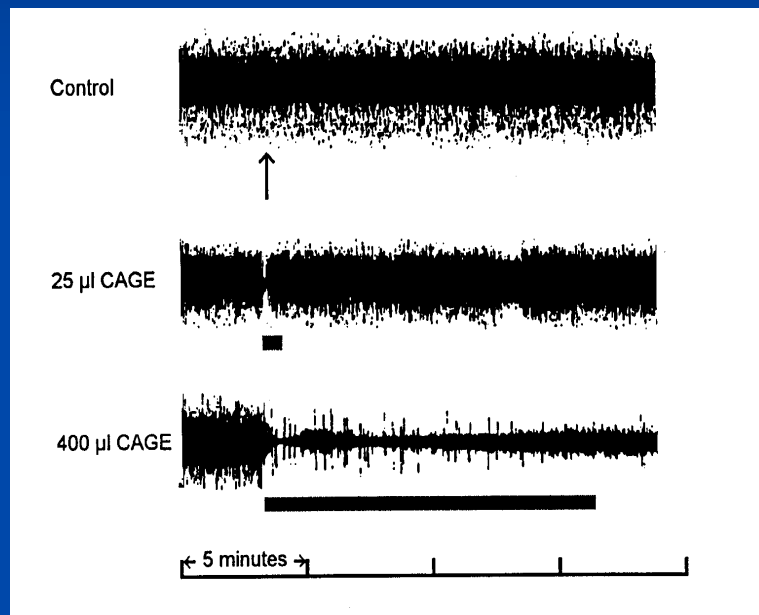
Leitch DR, et al *Undersea Biomed Res* 11:221, 1984

Emboli Don't Stay in Vessels Even Without Recompression



Courtesy of DF Gorman, MD
Helps S, et al. *Stroke* 21:1340, 1990

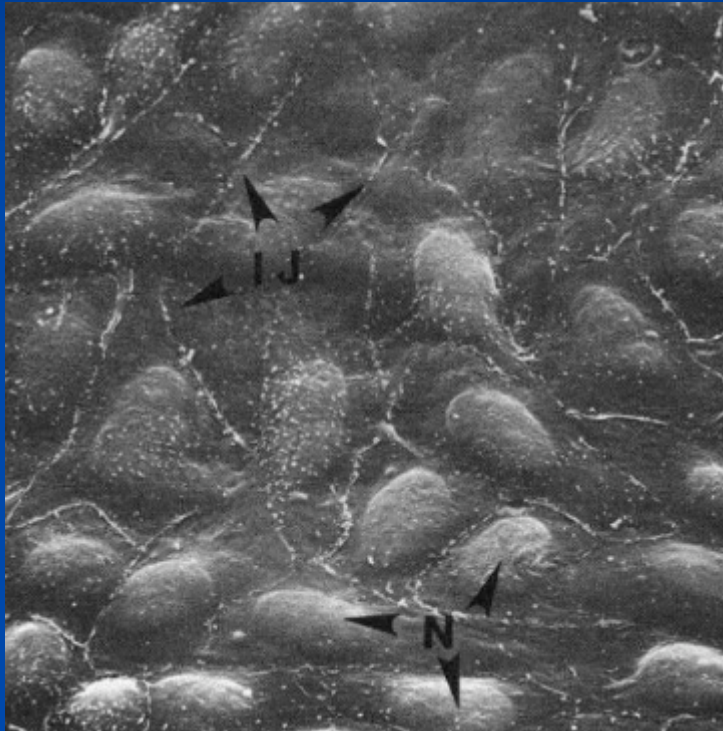
Effect of AGE on Cerebral Blood Flow



Helps SC, Gorman DF *Stroke* 22:351, 1991

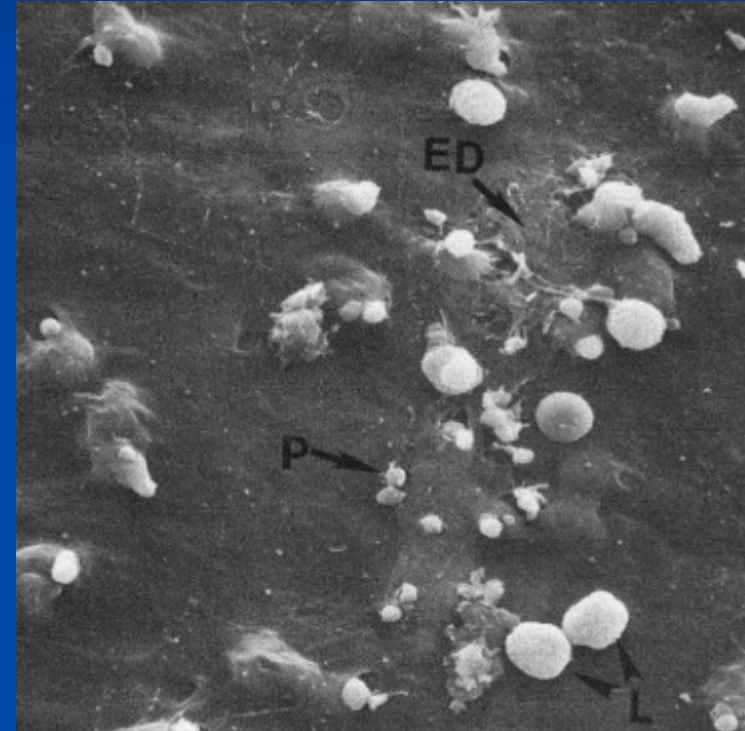
Effects of Bubbles on Endothelium: Leukocyte Adherence

Control



IJ = intercellular junctions
N = nuclei

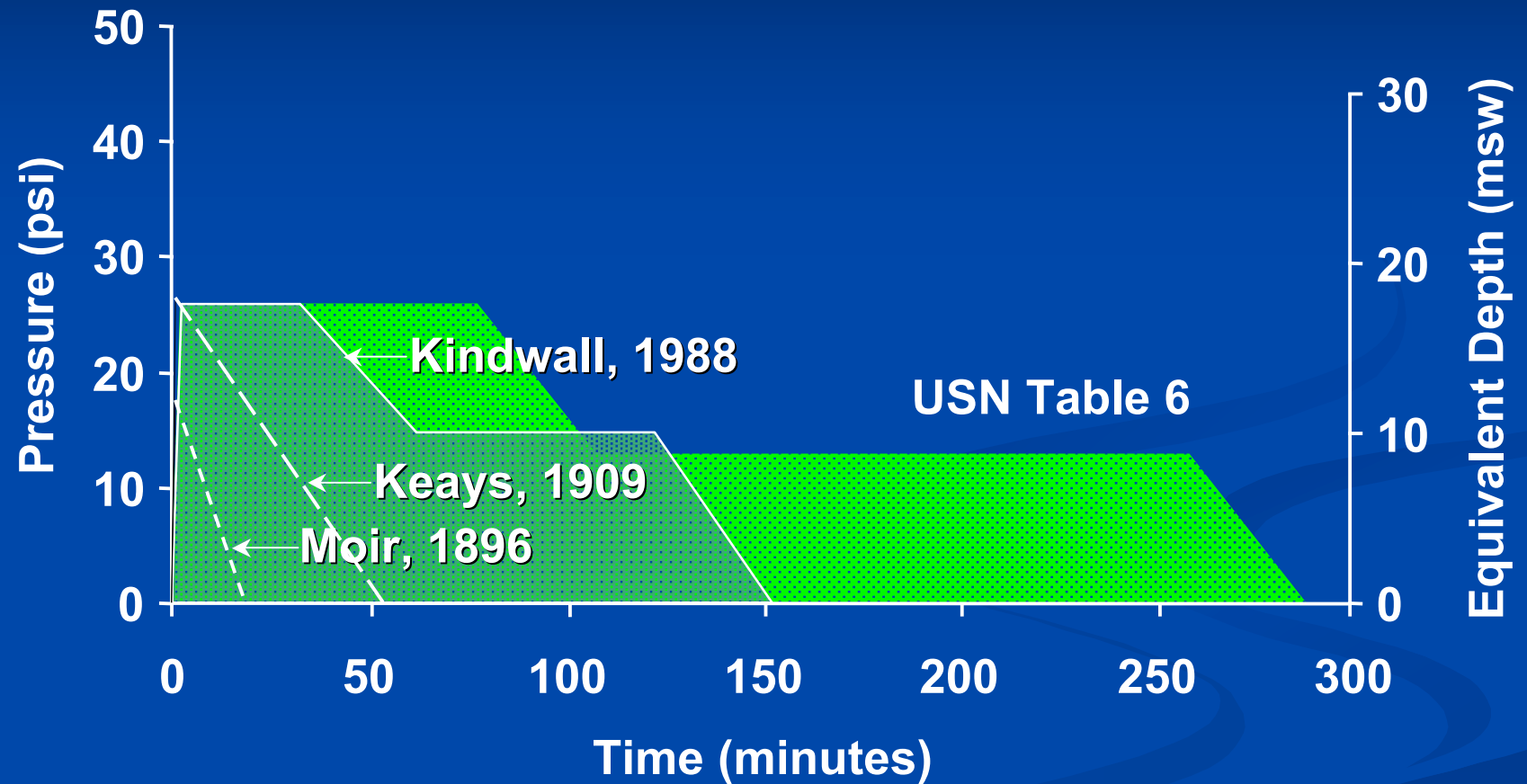
Decompression Sickness



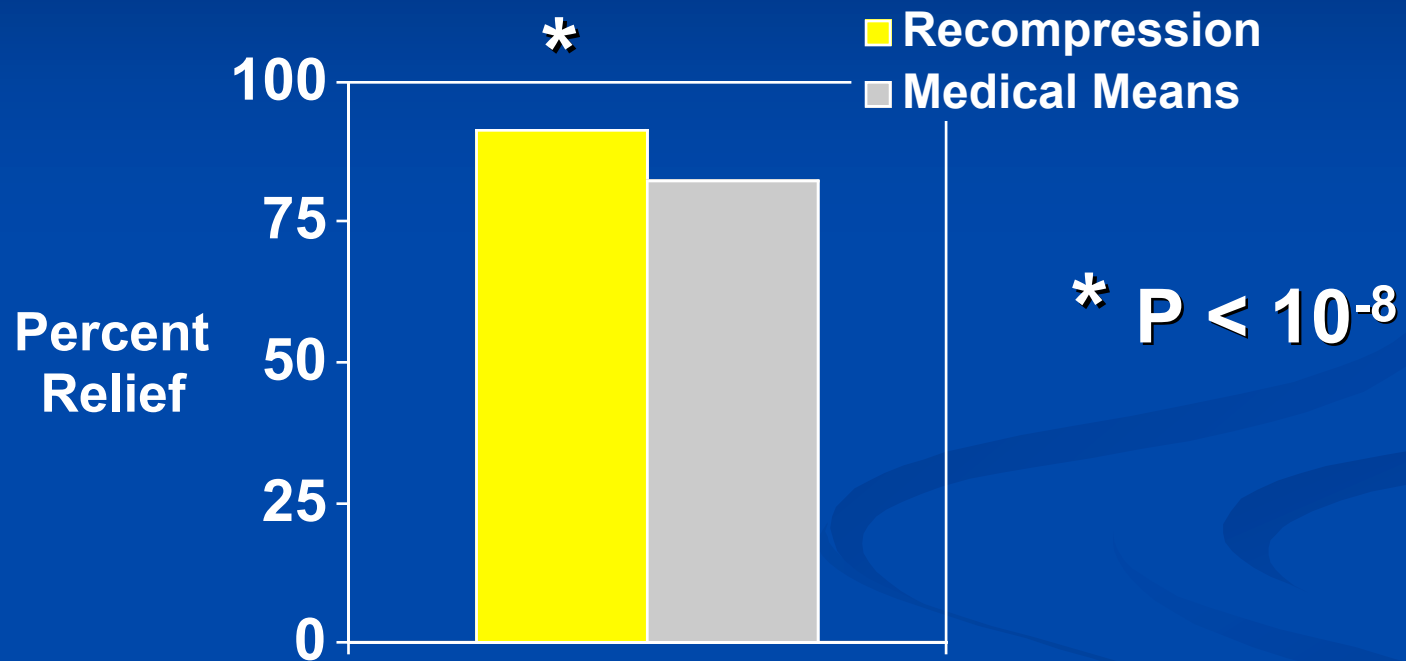
ED = endothelial damage
L = leukocytes; P = platelets

Levin *J Appl Physiol* 50:944, 1981

Recompression Tables

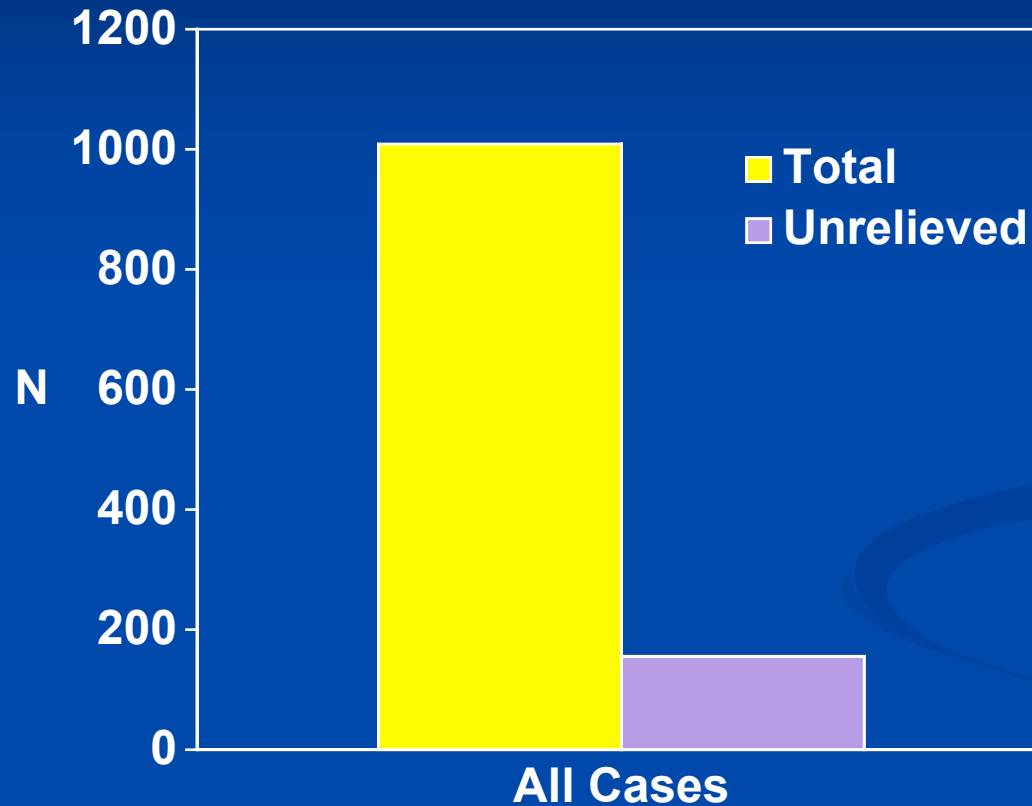


Bends in 1067 Tunnel Workers



Keays FL, 1909

Experience 1946-64: USN

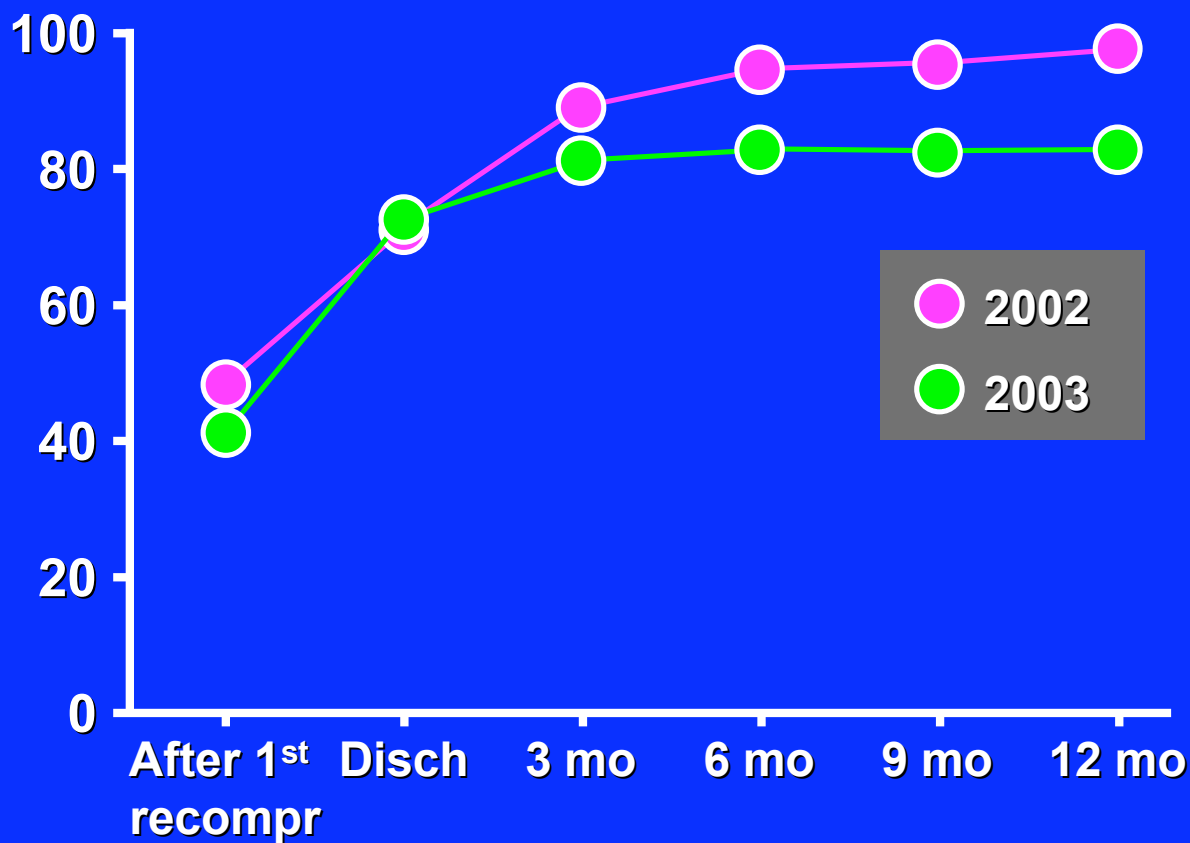


Goodman & Workman, 1965

Initial Treatment Table USN 5 or 6

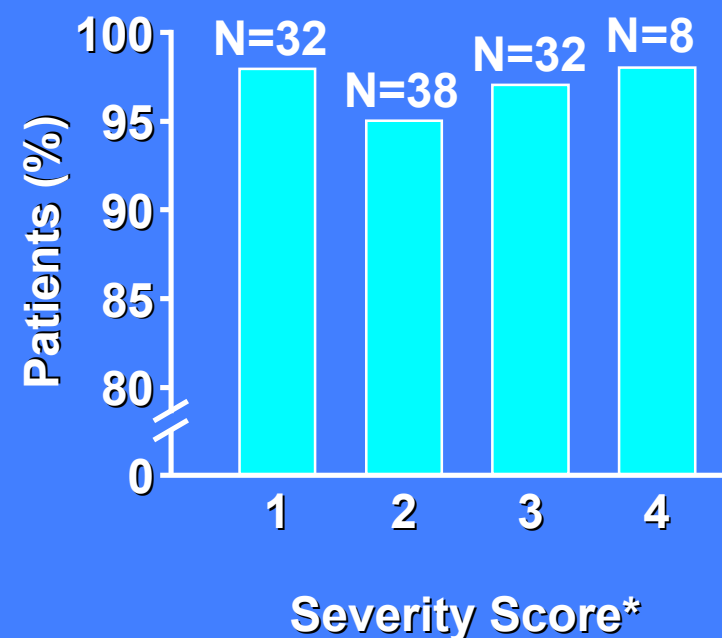
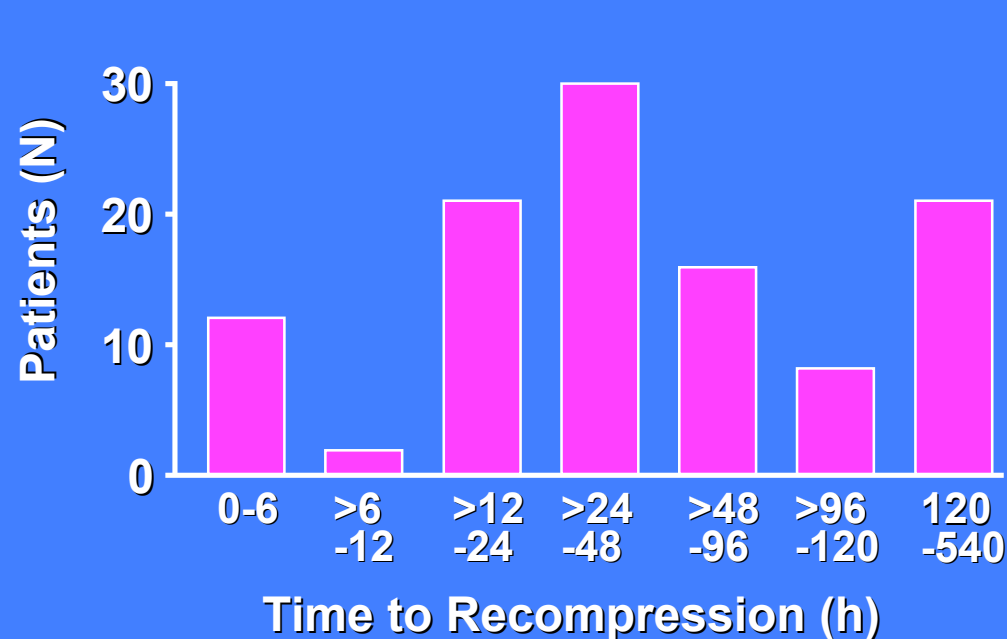
Author	N	Relief		Comments
		Complete (%)	Substantial (%)	
<i>Workman (1980)</i>	150	85	95	<i>After 2nd rx</i>
<i>Pearson & Leitch (1972)</i>	28	67	83	
<i>Davis (1977)</i>	145	98		<i>Altitude DCI</i>
<i>Erde & Edmonds (1975)</i>	106	81		
<i>Bayne (1978)</i>	50	98		
<i>Kizer (1979)</i>	157	58	83	<i>Long delays</i>
<i>Yap (1980)</i>	58	50		
<i>Gray (1984)</i>	812	81	94	
<i>Green (1989)</i>	208	96		<i>All type I (USN 5)</i>
<i>Ball (1993)</i>	14	93		<i>Mild</i>
	11	36		<i>Moderate</i>
	24	8		<i>Severe</i>
TOTAL	1763	80		

Complete Relief in Recreational Diver DCI



Divers Alert Network

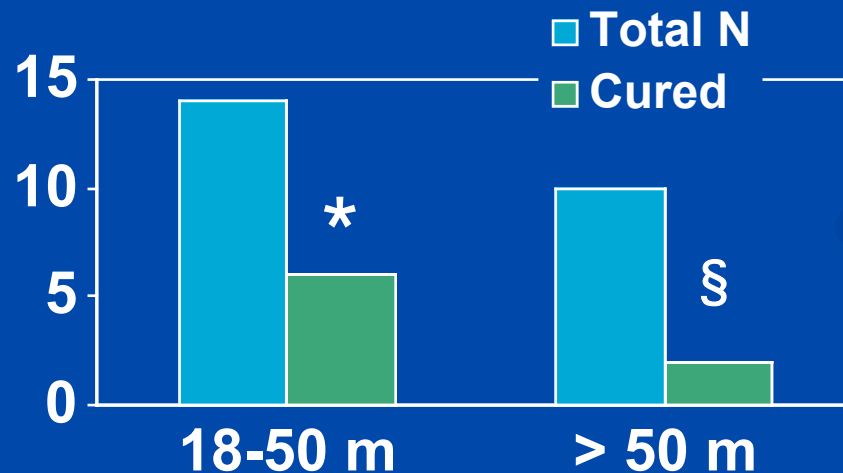
Complete Relief in Recreational Diver DCI



1 = Joint pain, malaise, skin, lymphatic
2 = Paresthesias, numbness, mild neuro
3 = Significant motor weakness, major sensory, balance, gait or mental impairment
4 = Paresis, paralysis, bladder, bowel, erectile dysfunction, other major CNS

Compression Deeper than 18 m

- 430 cases of DCS reviewed
- 24 cases compressed from 18 m to 50 m (air); 10 deeper than 50 m

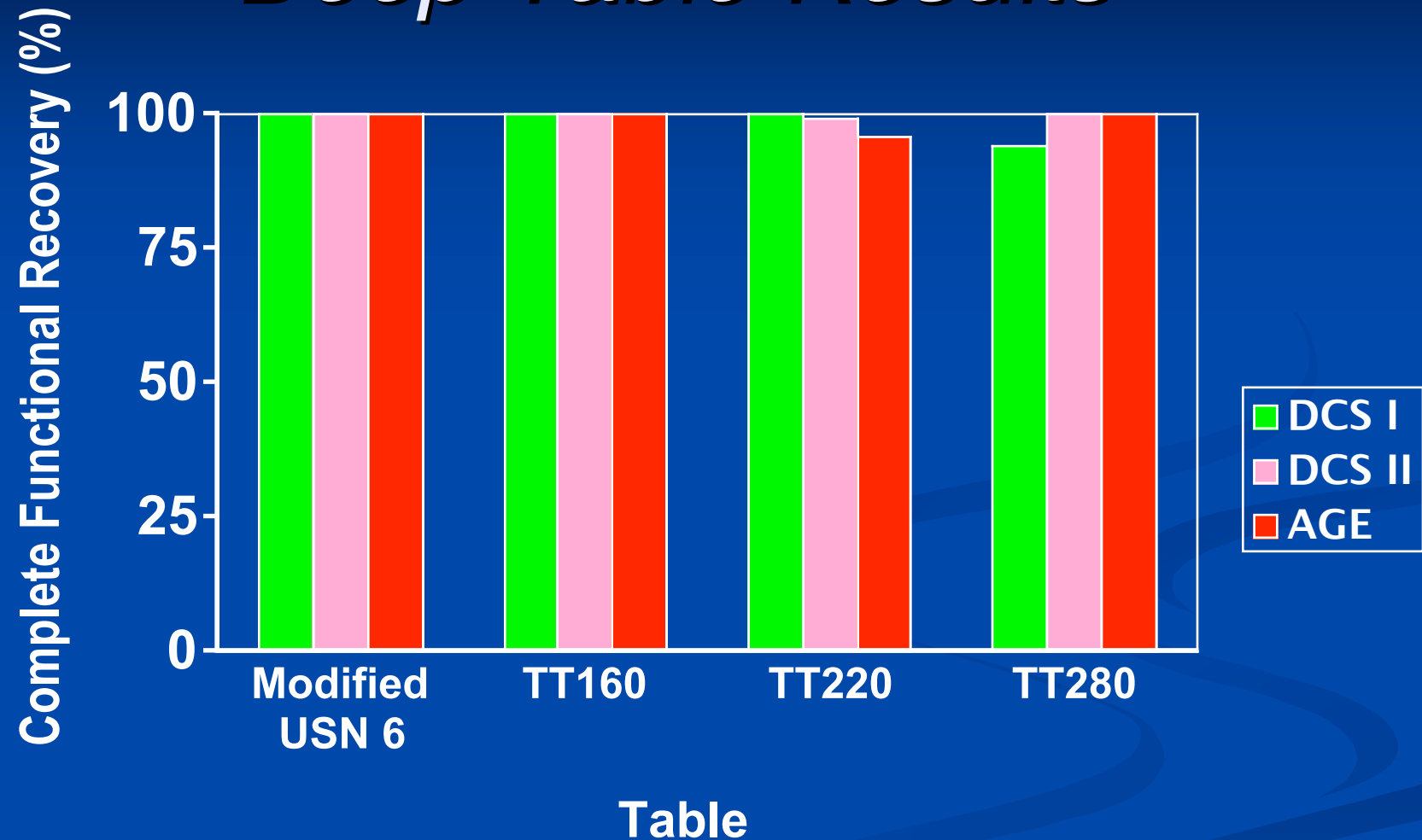


* 2 already improving at 18m; 1 sensory only; 1 relapsed during decompression

§ Sensory only

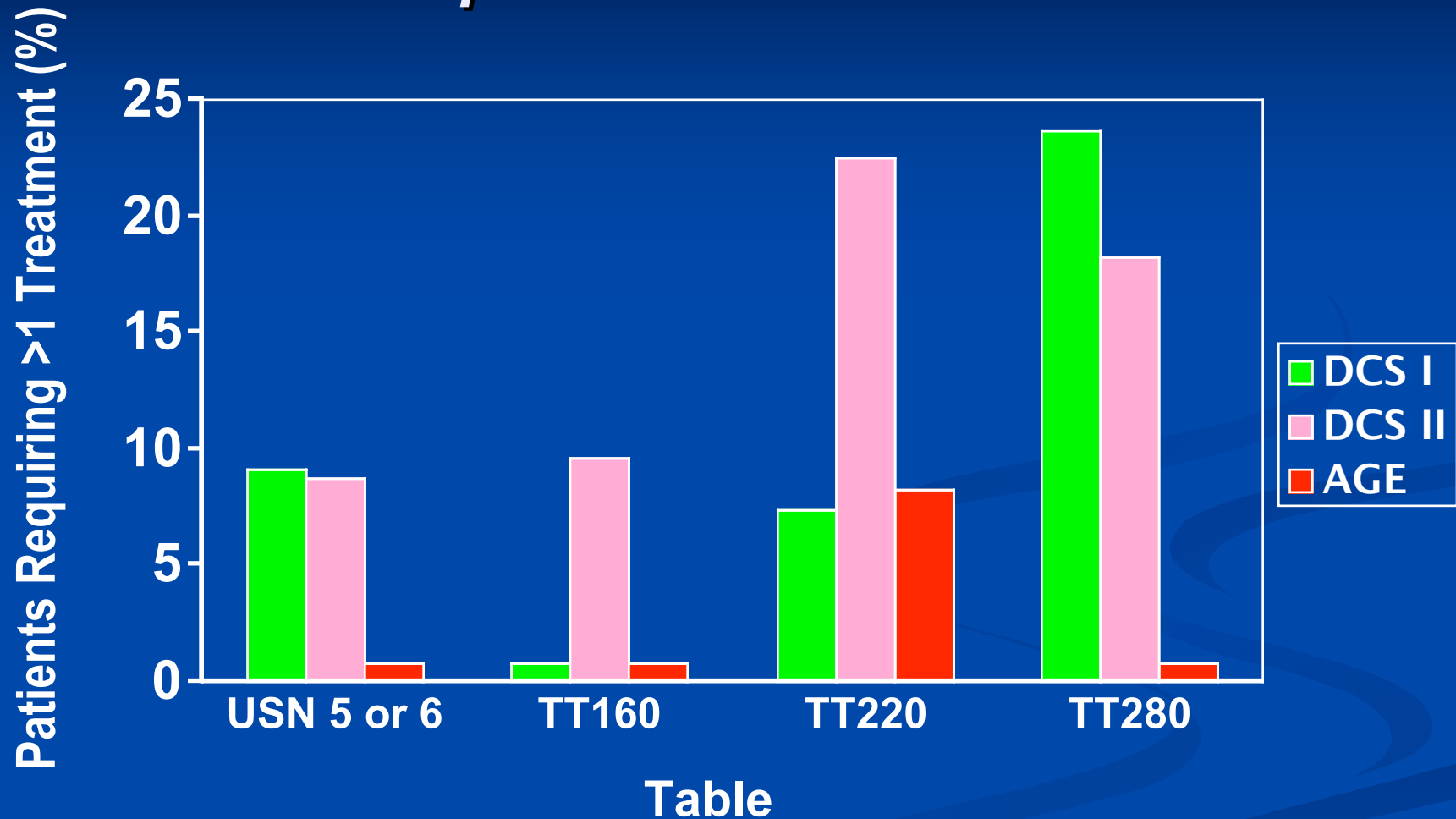
Leitch DR, Green RD *Aviat Space Environ Med* 56:1139, 1985

Deep Table Results



Smerz RW, et al. *Undersea Hyperb Med* 32:185, 2005

Deep Table Results



Smerz RW, et al. *Undersea Hyperb Med* 32:185, 2005

Hypothesis

**For the treatment of decompression illness,
deep tables are more efficacious than
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Hypothesis

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standard USN oxygen tables

Unproven