Stereoscopy-based Computerized Evaluation of Microneurosurgery Skills

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Introduction

Neurosurgical Procedures

- Complex procedures
- Margin of error is very low: Lethal consequences
- MIS: Microscopic & Endoscopic Surgery
- Rising health costs

Iatrogenic errors have drawn increasing attention to surgical techniques and dexterity of thesurgeons, that require elaborate and effectual training, especially, **Micro-surgical techniques**.

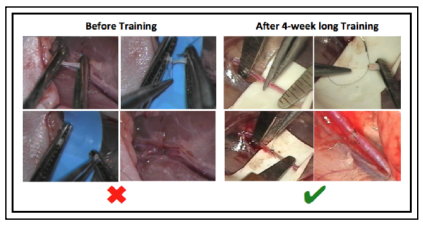
- Dural Repair
- Nerve and Blood Vessel Anastomosis

Global Scenario

- Europe, US & Japan: 1 neurosurgeon: 75,000
- South Asia & Africa: 1 neurosurgeon: 10,00,000

But most of the institutions in the world, lack facilities for continuing education and skills training in neurosurgery.

No validated skills training/clinical curriculum:Neurosurgery Apprenticeship Model: No longer occupy the first place in advanced surgical disciplines like neurosurgery.



2 Step Methodology: Neurosurgery Skills Training Facility

Step I: Formulation, standardization & validation of skills training curriculum of neurosurgery MCh & DNB

SKILLS	SR1 (3 YEAR MCH) / SR3 (6 YEAR MCH)	SR2 (3 YEAR MCH) / SR4 (6 YEAR MCH)	SR3 (3 YEAR MCH) SR 5+POST MCH (6 YEAR MCH)
SUTURING	SUTURING ON SYTHETIC AND SEMI-SYNTHETIC MODELS (4-0 TO 10-0)	NERVE ANASTOMOSIS	VESSEL ANASTOMOSIS

Basic Microsuturing Course on Synthetic & Semi-synthetic Material:-

Suture	Material	Magnification
4-0	Silk	2.72
		4.08
5-0	Silk	4.08
		6.8

Advanced Microsuturing Course on Synthetic & Semi-synthetic Material:-

Suture	Material	Magnification
7-0	Monofilament	6.8
		10.88
9-0	Monofilament	6.8
		10.88
		12
10-0	Monofilament	10.88
		12

Step II: Computerized Evaluation & Assessment System to grade the surgical skills of Neurosurgeons

- Un-biased Grading
- Quantitative Analysis
- Individually-Collectively
- Un-supervised & Supervised learning

Assessment Methodology: Broken into Components

I. Angle/Direction of Knot wrt Cut
II. Inter-sutural Distance
III. Thickness of the Bites w/d Approximation"
IV. Instrument Depth

Notable characteristics: Microsurgical techniques

- **Effectualness**
- **Eye-hand Co-ordination**
- **Dexterity**

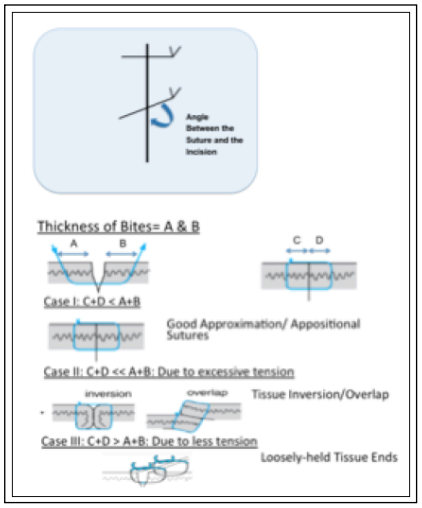
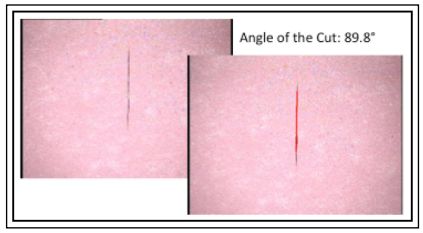


Image Processing Techniques

- Multi-resolution Approach
- Plane Induced Parallax
- Projective Depth
- Morphological operations
- Tracking Algorithms

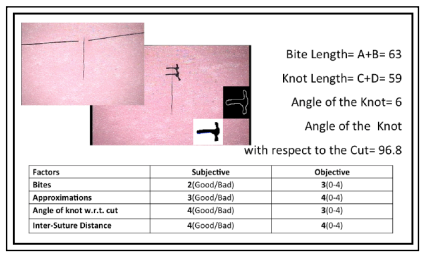
Results

I. Cut Inclination & Length



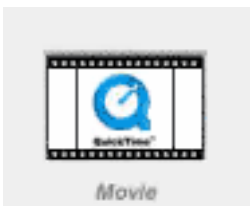
II. Length of Bites (A+B)

III. Knot Inclination and Length

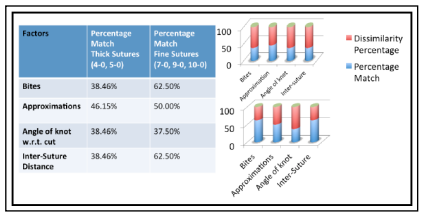


Factors	Subjective	Objective
Bites	2(Good/Bad)	3(0-4)
Approximations	3(Good/Bad)	4(0-4)
Angle of knot w.r.t. cut	4(Good/Bad)	3(0-4)
Inter-Suture Distance	4(Good/Bad)	4(0-4)

IV. Instrument Projective Depth



Computerized Objective Evaluation Vs. Subjective Evaluation



Factors	Percentage Match Thick Sutures (4-0, 5-0)	Percentage Match Fine Sutures (7-0, 9-0, 10-0)
Bites	38.46%	62.50%
Approximations	46.15%	50.00%
Angle of knot w.r.t. cut	38.46%	37.50%
Inter-Suture Distance	38.46%	62.50%

Objective analysis done by the computerized evaluation system has proven to be more accurate and a better judge of microsuturing techniques/performance.

References

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Conclusions

Objectivized assessment of micro-neurosurgical skills using stereoscopic technologies has shown an evident improvement in the standards of evaluation. This method of instruction helps the trainees improvise their surgical skills targeted-ly, resulting in foreshortening and strengthening their