Microneurosurgical repair of trigeminal nerve injuries using allograft techniques

University of Miami Hospital/ Jackson Health System

Academic Day 2018

Disclosures

Potential conflict of interest relationships are germane to my presentation–
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Status of FDA devices used for the material being presented: None

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Neurosurgical repair of peripheral cranial nerves using allograft techniques

- Nerve anatomy & physiology
- Nerve injury– classification and neurodegeneration
- Neuroregeneration
- Nerve repair with allografts
- Inferior alveolar and lingual nerve repairs

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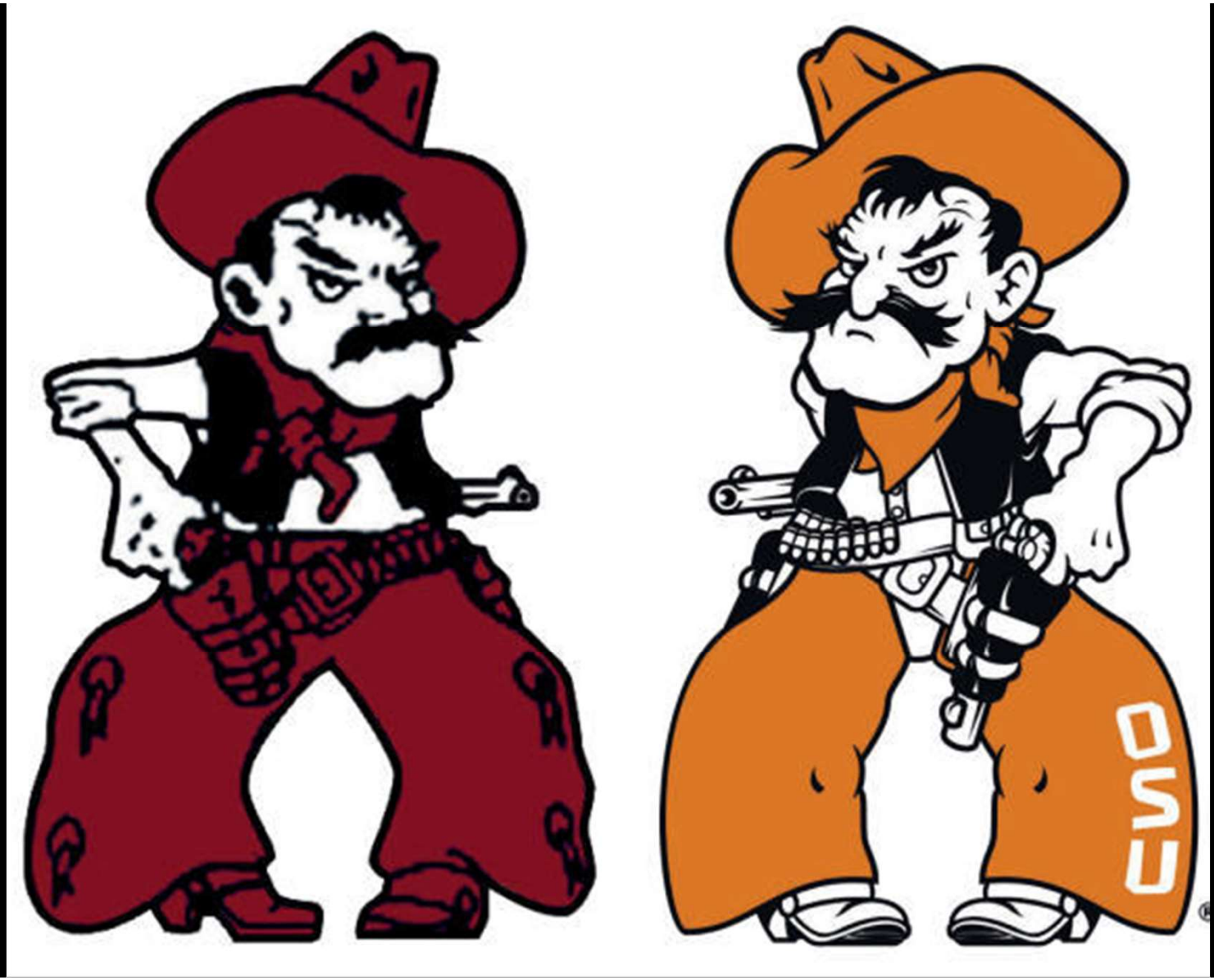
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UNDEFEATED 1960
AGGIE FOOTBALL TEAM


Record 40,000 in attendance to watch Arizona Bowl
Arizona Daily Star
AGGIES WIN!
New Mexico State wins the 2017 Nova Home Loans Arizona Bowl!
ARIZONA BOWL
THE WILDCASTER
UA SPORTS NEWS, VIDEOS, PODCASTS AND MORE!
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GRACIAS
THANK YOU
NOVA

Iatrogenic Injury of the Trigeminal Nerve

Mechanism

Lingual Nerve – 3rd molar removal

Inferior Alveolar Nerve – 3rd molar removal, Crush injury, Endodontic Injury, Lacerations injury, Injury at the mental foramen and beyond, Reconstruction of the resection defect

Incidence of Trigeminal Nerve Injury during 3rd Molar Extraction

Frequency of Trigeminal Nerve Injuries Following Third Molar Removal

Richard C. Robert, DDS, MS, Peter Bacchetti, PhD,† and M. Anthony Pogrel, DDS, MD‡*

Purpose: To estimate oral and maxillofacial surgery reporting of the frequency of temporary and permanent inferior alveolar and lingual nerve damage from lower third molar extraction and injury etiology, and to identify factors associated with injury rates.

Materials and Methods: A postal survey was sent to all members of the California Association of Oral and Maxillofacial Surgeons requesting information on known instances of inferior alveolar and lingual nerve damage that had occurred in their practices over a 12-month period and known instances of permanent damage over their entire careers.

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Injury to the trigeminal nerve risk factors

Lingual

Distoangular impaction, chronic pericoronitis, lingual orientation

Inferior alveolar

Depth of impaction

Other risk factors

Age : >25, Gender : female, surgeon experience

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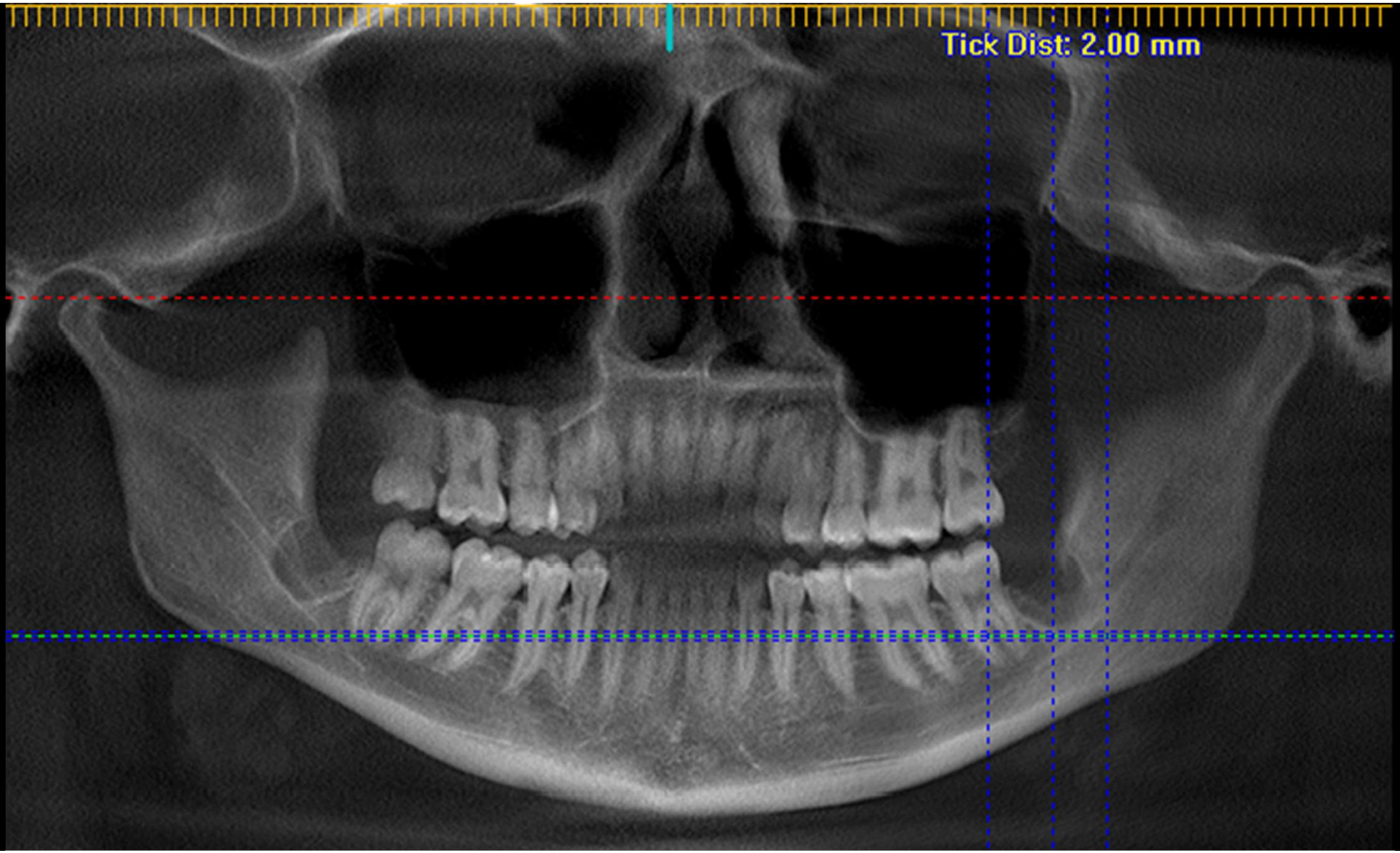
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J Oral Maxillofac Surg
47:1074-1078, 1989

Clinical Neurosensory Testing:
Practical Applications

G.E. GHALI, DDS,* AND BRUCE N. EPKER, DDS, PHD†

A relatively large percentage of the practicing oral and maxillofacial surgeon's patients experience some degree of neurosensory impairment as a normal concomitant of major surgery. Additionally, some patients develop neurosensory disturbances unexpectedly following routine surgical procedures. This report describes a practical approach to evaluating these individuals, which is essential in making intelligent decisions regarding the objective nature of the nerve injury, potential for recovery, and/or possible need for secondary microneurosurgical intervention.

Introduction

Maxillofacial neurosensory impairment may

Basic Concepts of Clinical Neurosensory Testing

Clinical neurosensory testing in generally divided

Conducting a neurosensory test

Mechanoceptive

Two-point discrimination: static light touch and brush directional stroke.

Nociceptive

Nociceptive testing is subdivided into pinprick and thermal discrimination.

Three-level drop-out algorithm

Level A: static two-point discrimination, brush-stroke directional
Level B: contact detection
Level C: pinprick nociception, thermal discrimination

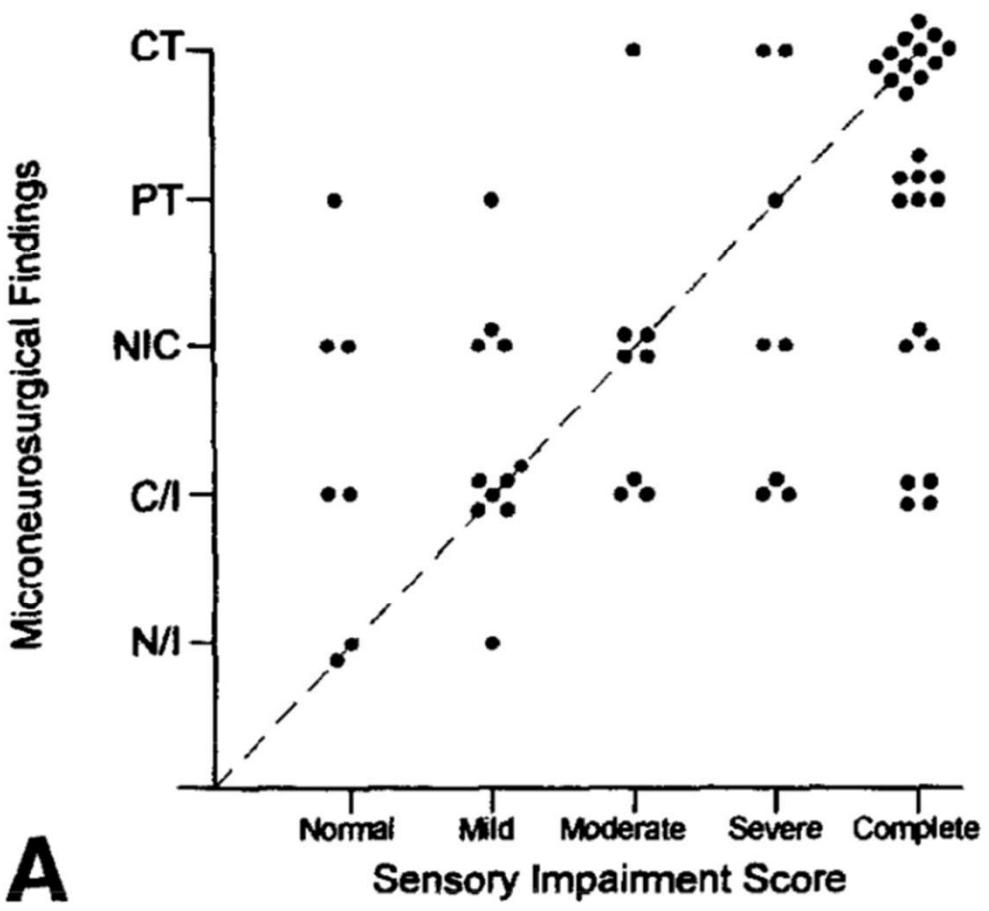
CLINICAL ARTICLES

J Oral Maxillofac Surg
56:2-8, 1998

The Accuracy of Clinical Neurosensory Testing for Nerve Injury Diagnosis

*John R. Zuniga, DMD, PhD, MS,**
Roger A. Meyer, DDS, MD,† John M. Gregg, DDS, PhD, MS,‡
Michael Miloro, DMD, MD,§ and Leon F. Davis, DDS, MS, MD‖

Purpose: The accuracy of the clinical neurosensory test to diagnose trigeminal nerve injuries has never been statistically evaluated. The purpose of this study was to determine the statistical efficacy of the clinical neurosensory test using surgical findings as the "gold" standard, and to determine whether a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Sensory Impairment Score
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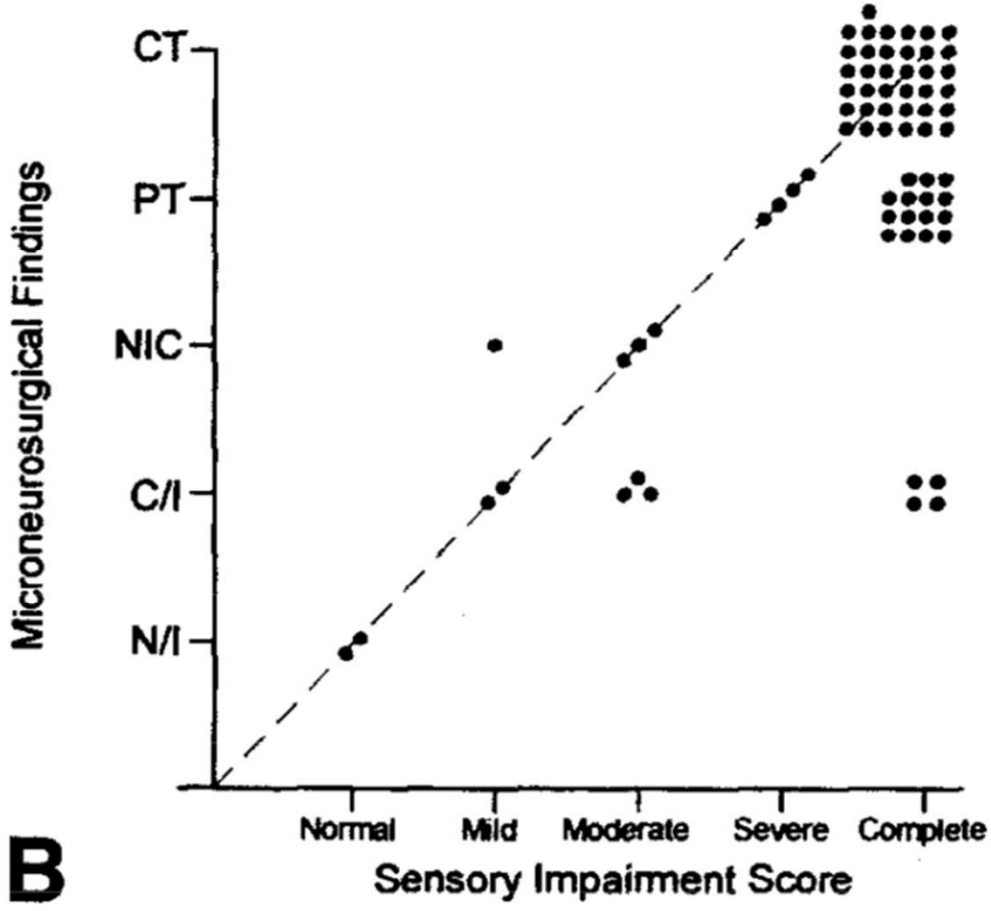
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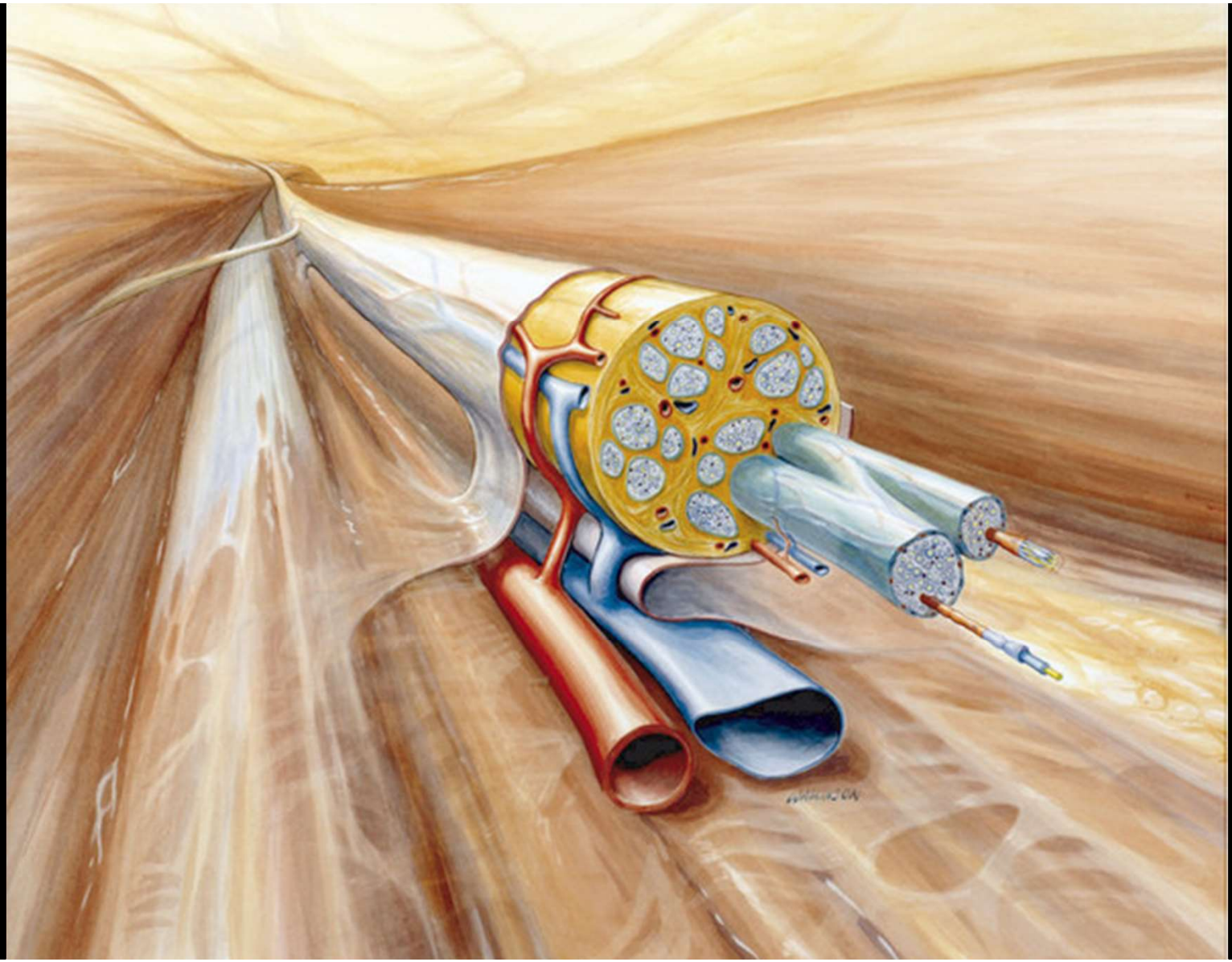
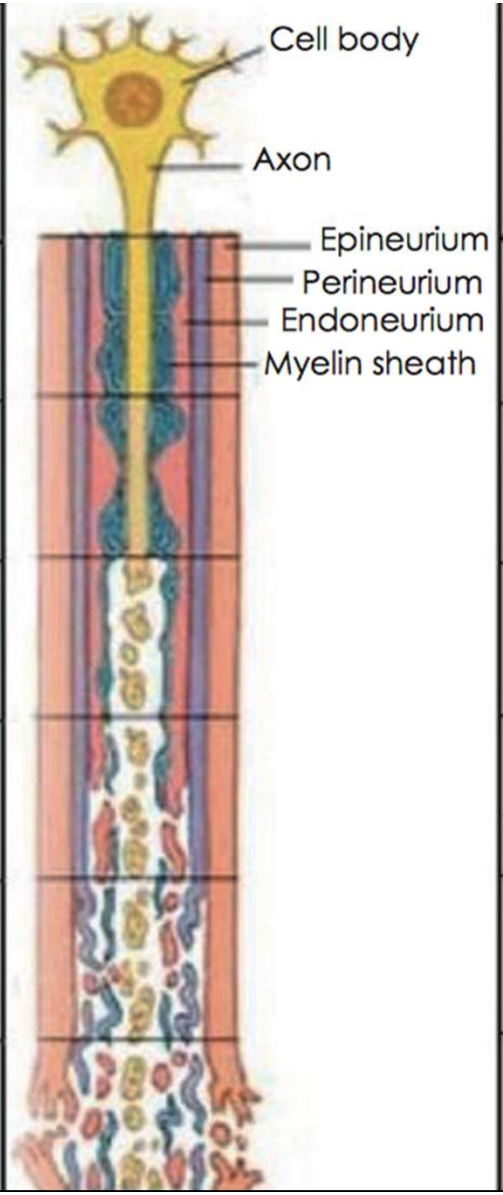
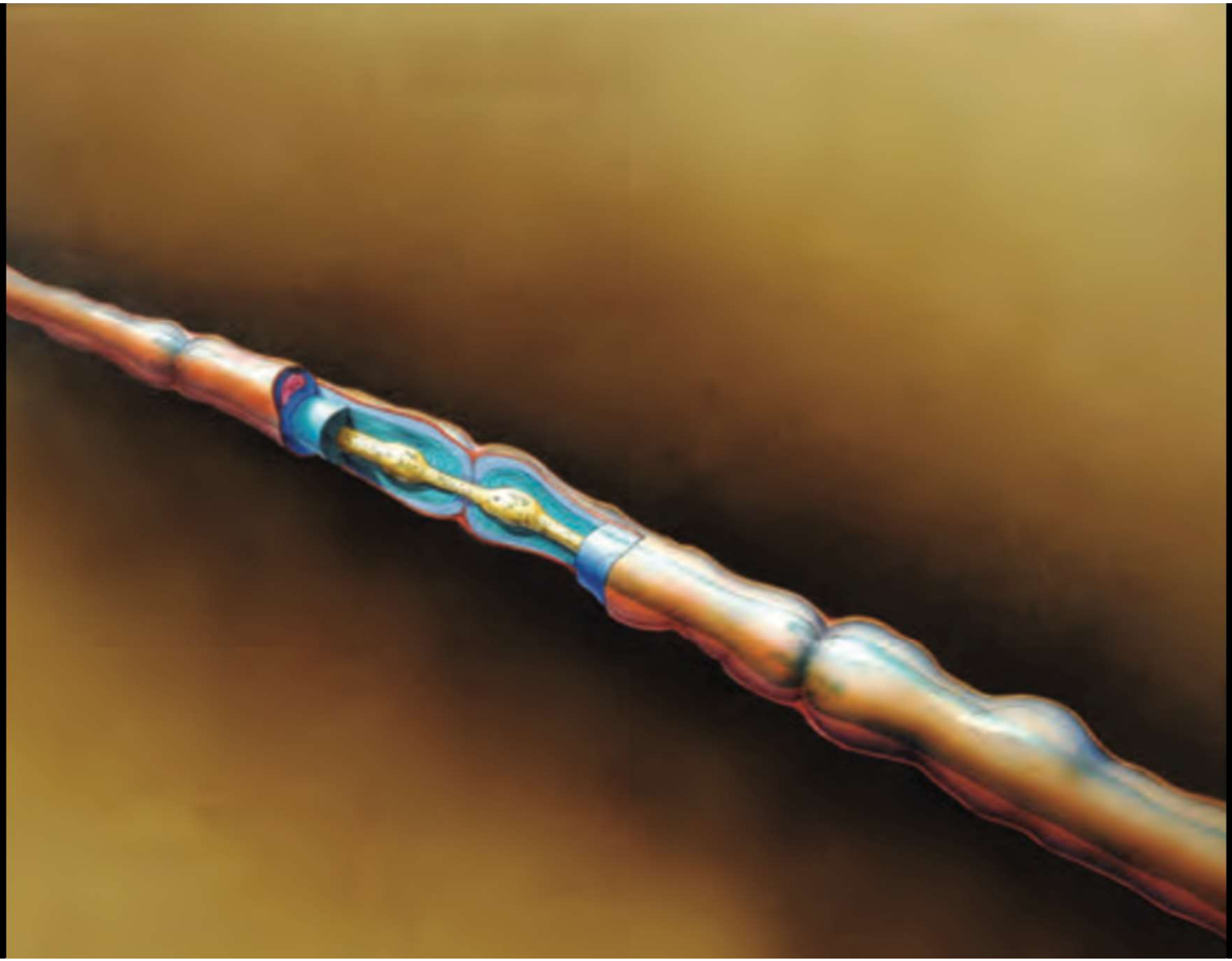


Seddon	Sunderland	Injury	Degeneration	Regeneration
Normal		Normal	Normal	Normal
Neuropraxia	First degree	Myelin sheath (M)	Conduction block	Complete recovery
Axonotmesis	Second degree	M+Axon (A)	Wallerian degeneration	
Neurotmesis	Third degree	M+A +Endoneurium (E)		Incomplete recovery
	Fourth degree	M+A+E +Perineurium (P)		
	Fifth degree	M+A+E+P +Epineurium		





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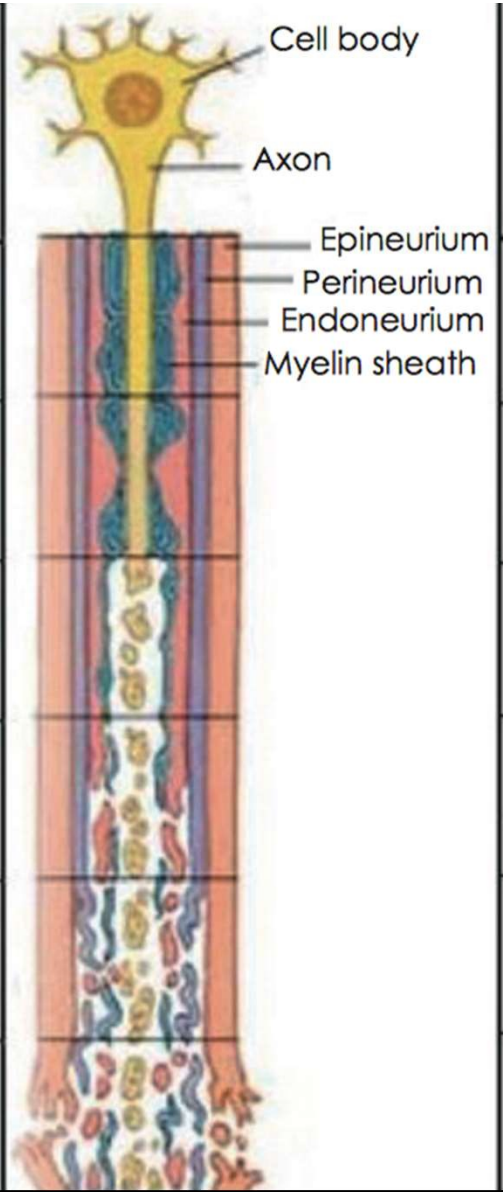

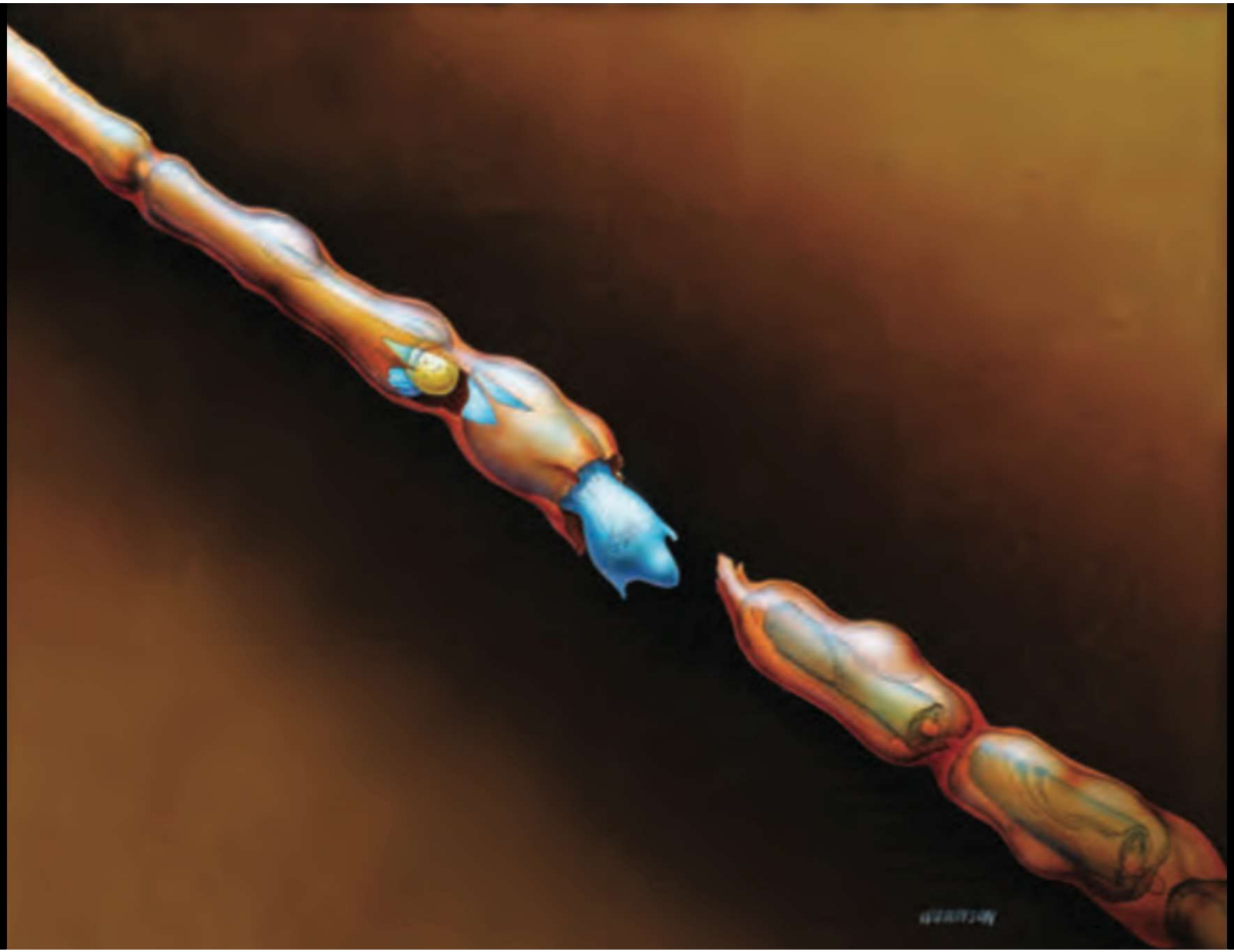

Timing of microsurgical repair

Medications
- High dose steroids, tapered dose
- Vitamin B complex
- Gabapentin/Lyrica

Timing is critical for 3 main reasons
- Distal nerve degeneration
- Nerve cell bodies at the ganglion die
- Central cortical changes

Lingual versus inferior alveolar
- 1 to 3 months LN
- 3 to 6 months IAN

Indications for neurosurgical repair

Indications for surgical repair
- Persistent paresthesia that fails to improve over successive examinations
- Anesthesia
- <50 % sensation Grade III?, IV and V
- Observed transection
- Early pain (neuroma formation)

Contraindications
- Grade I,II, and III? injuries
- Continued improvement

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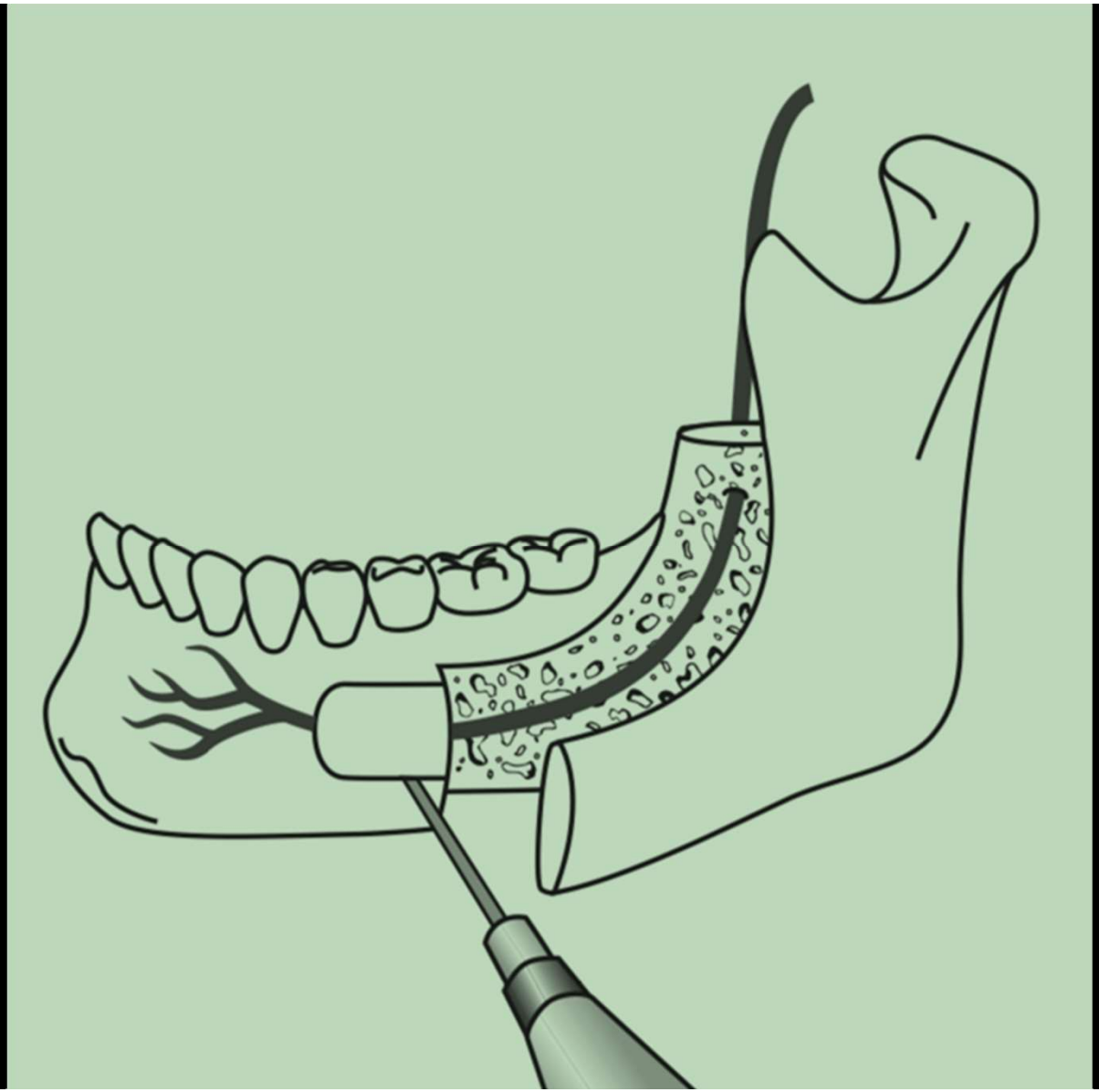

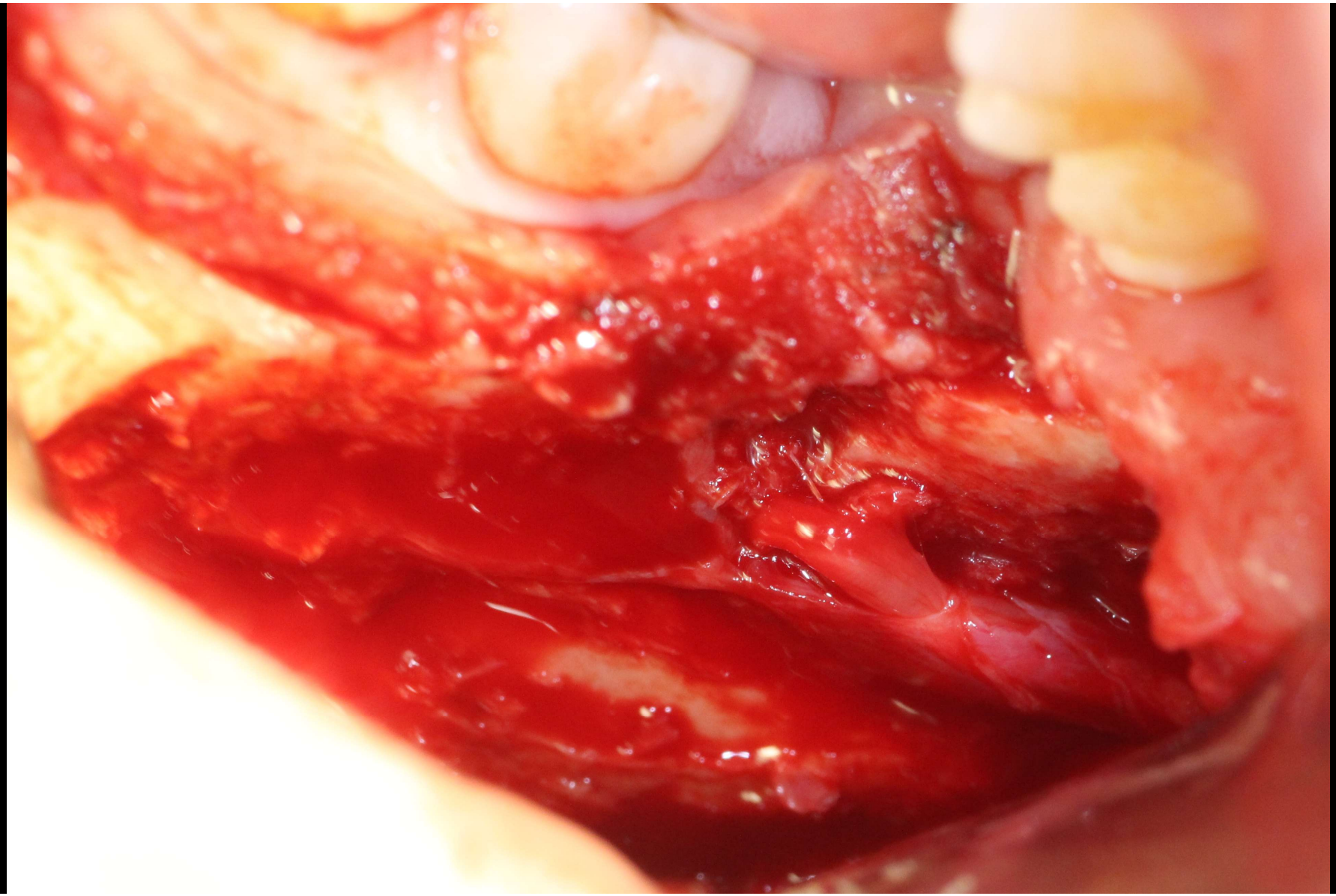

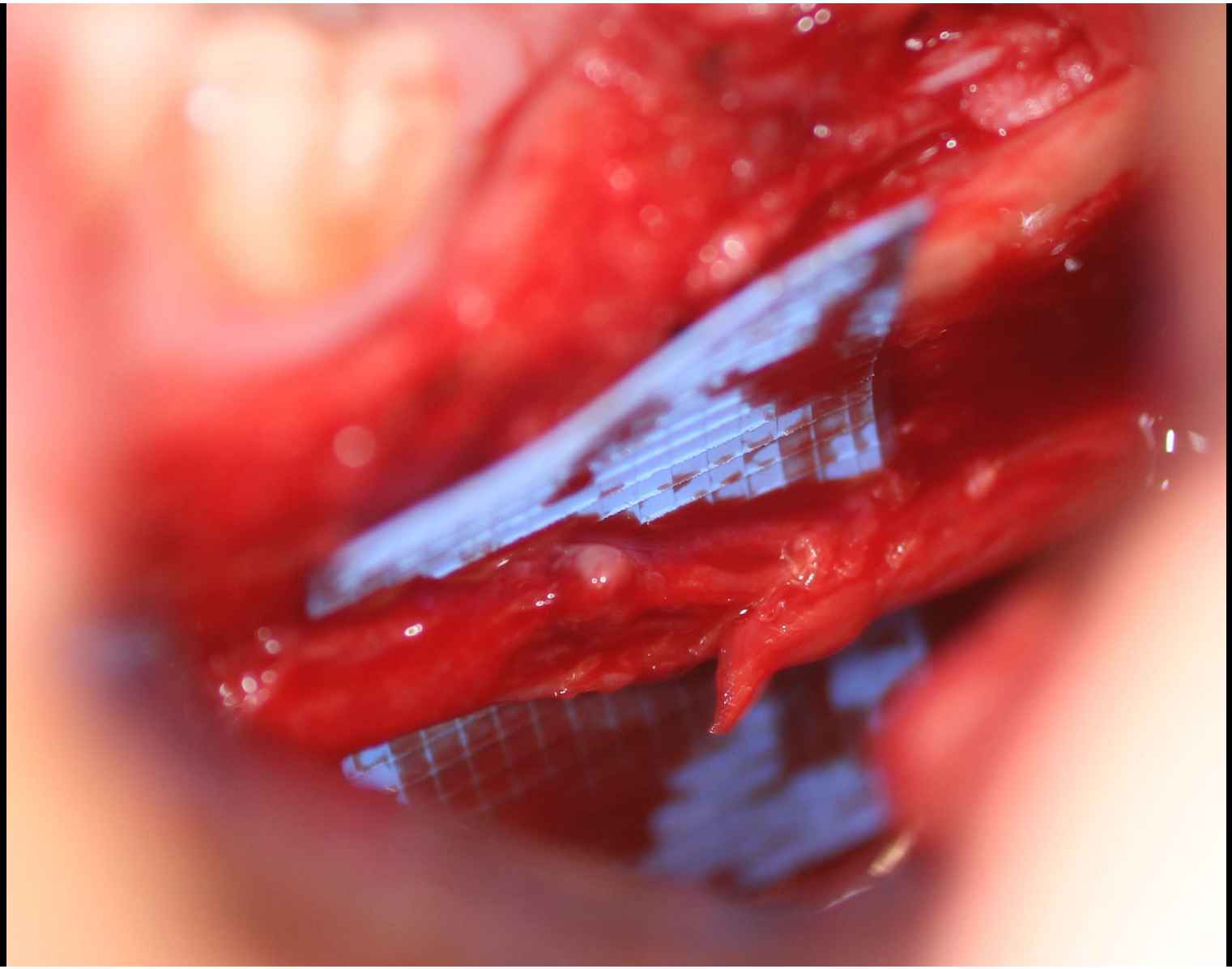

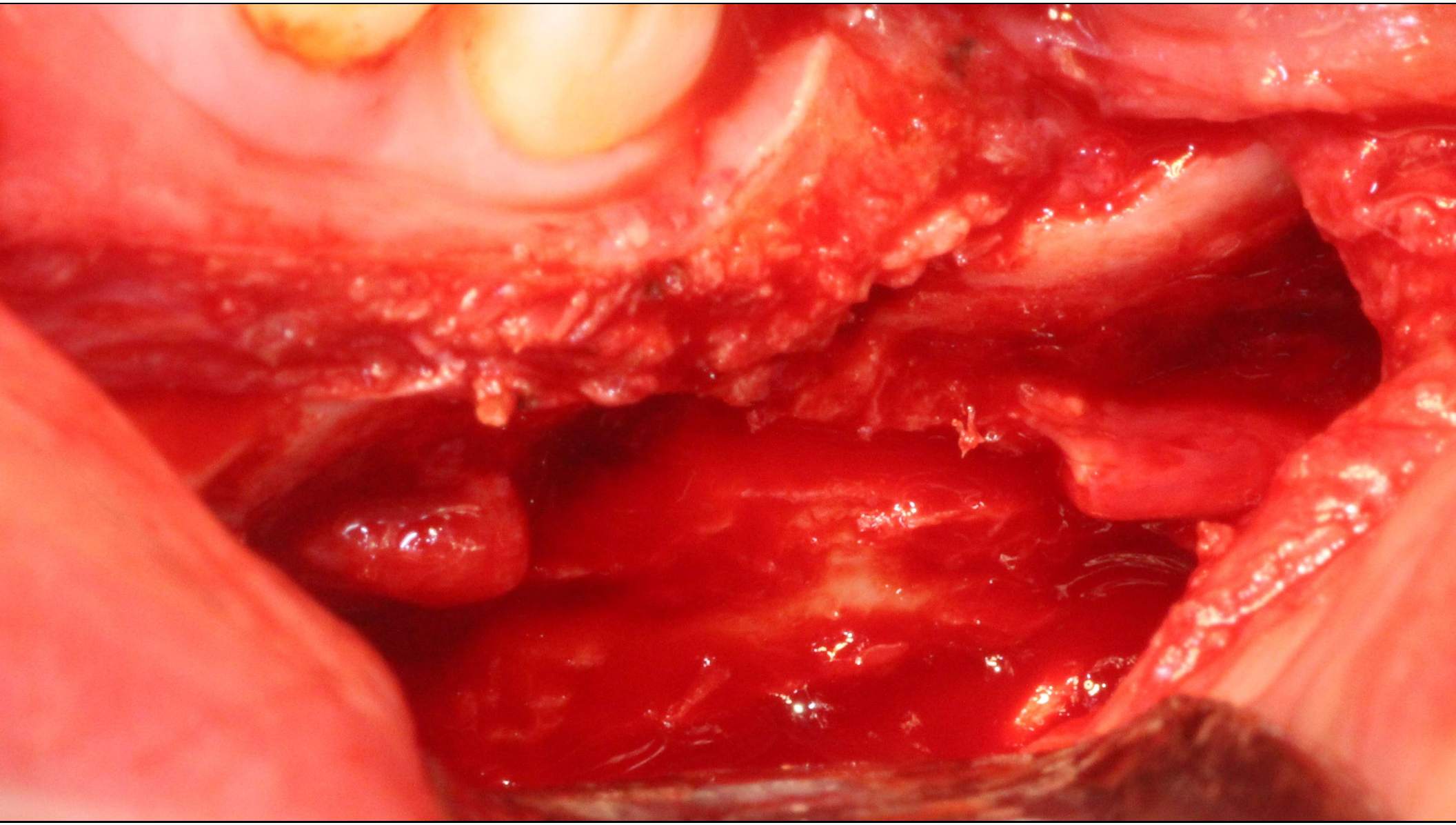

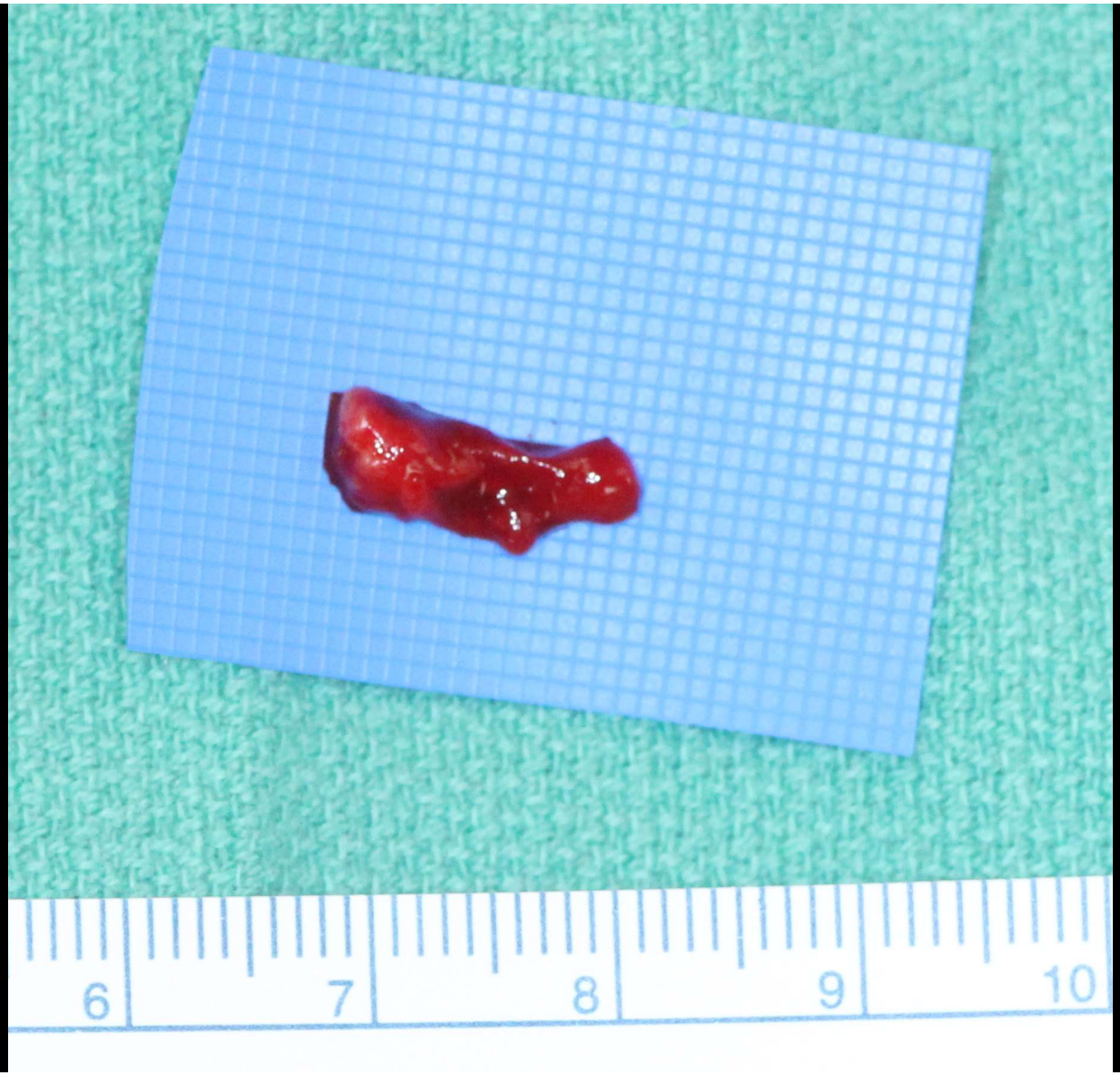
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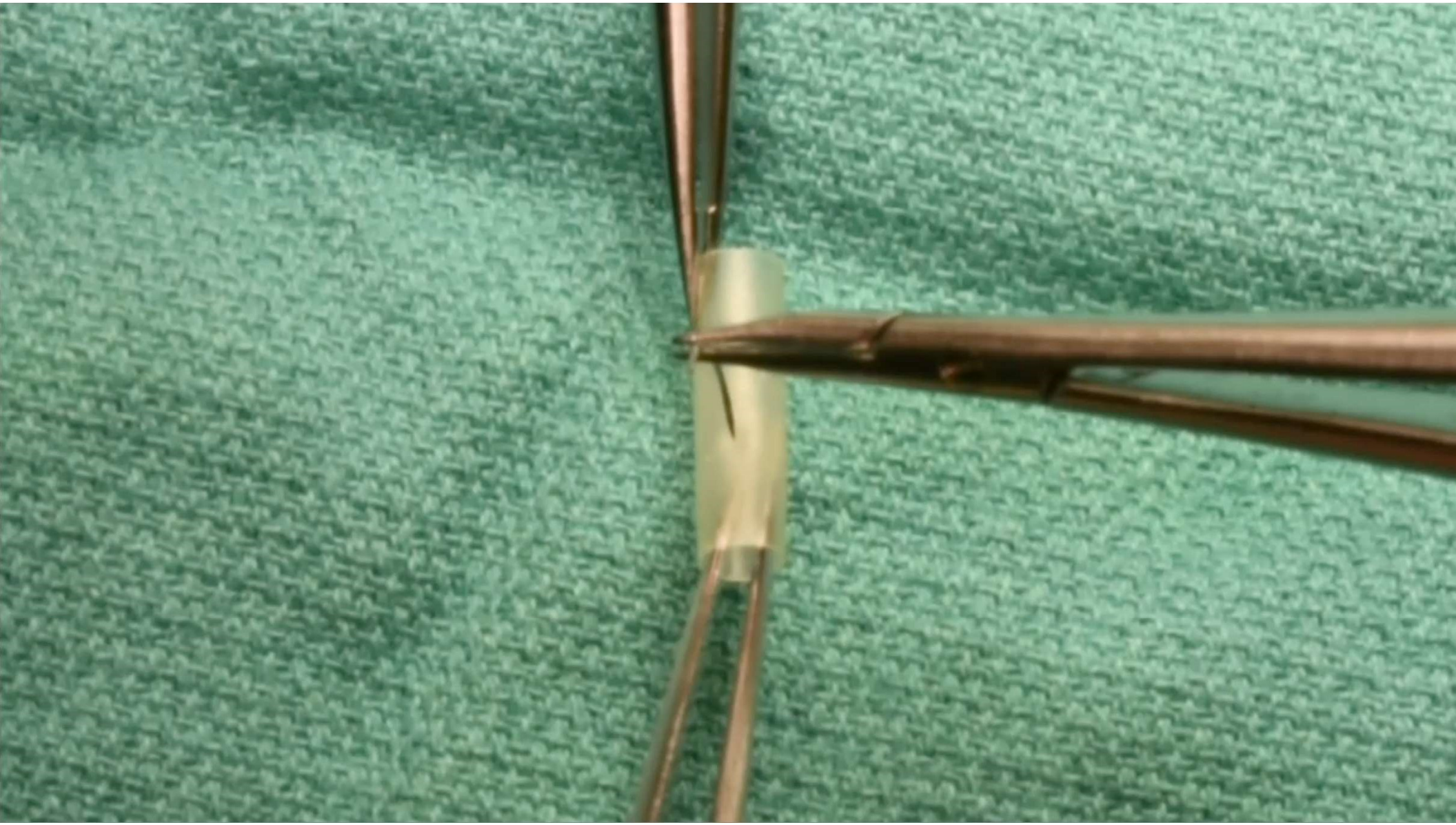


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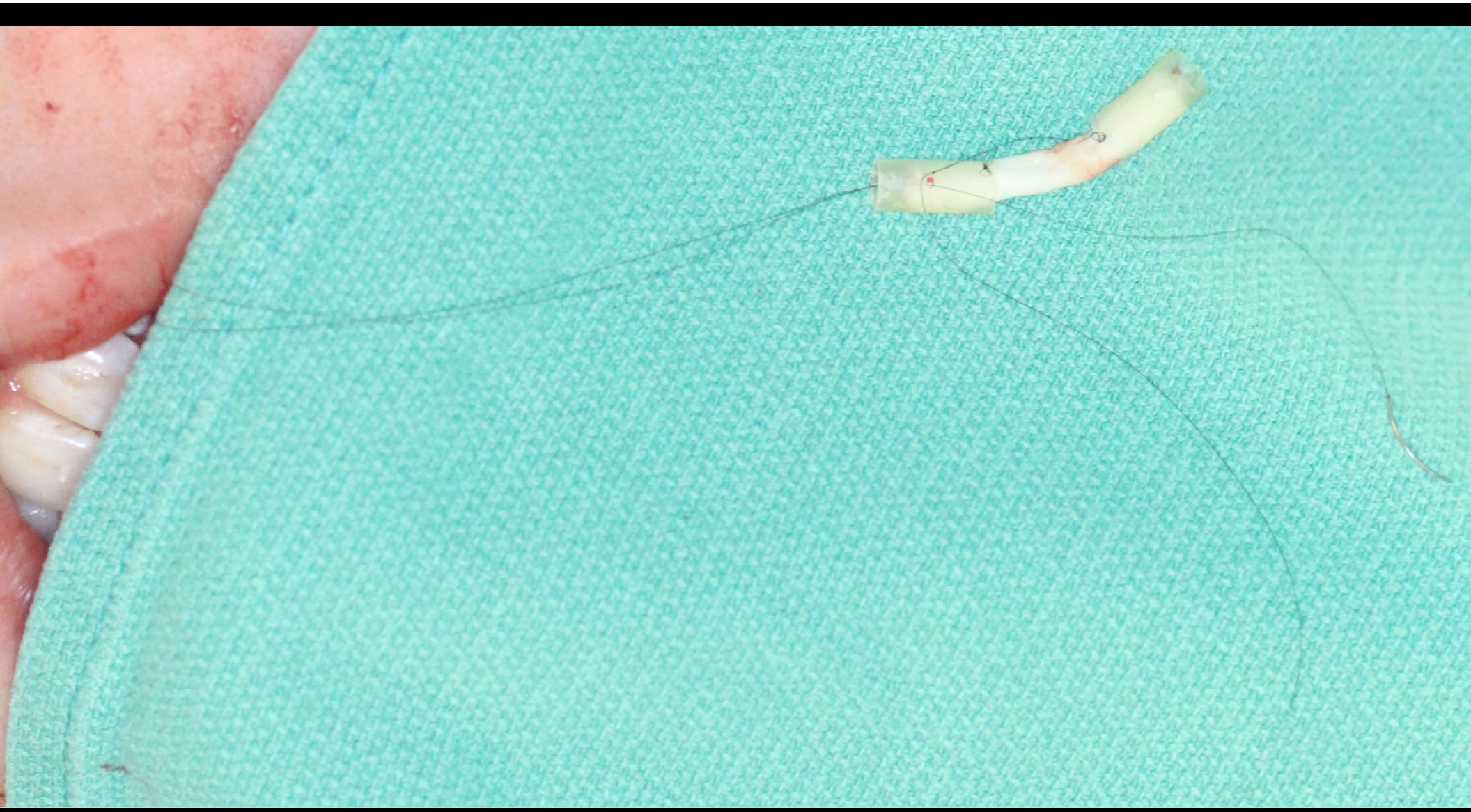

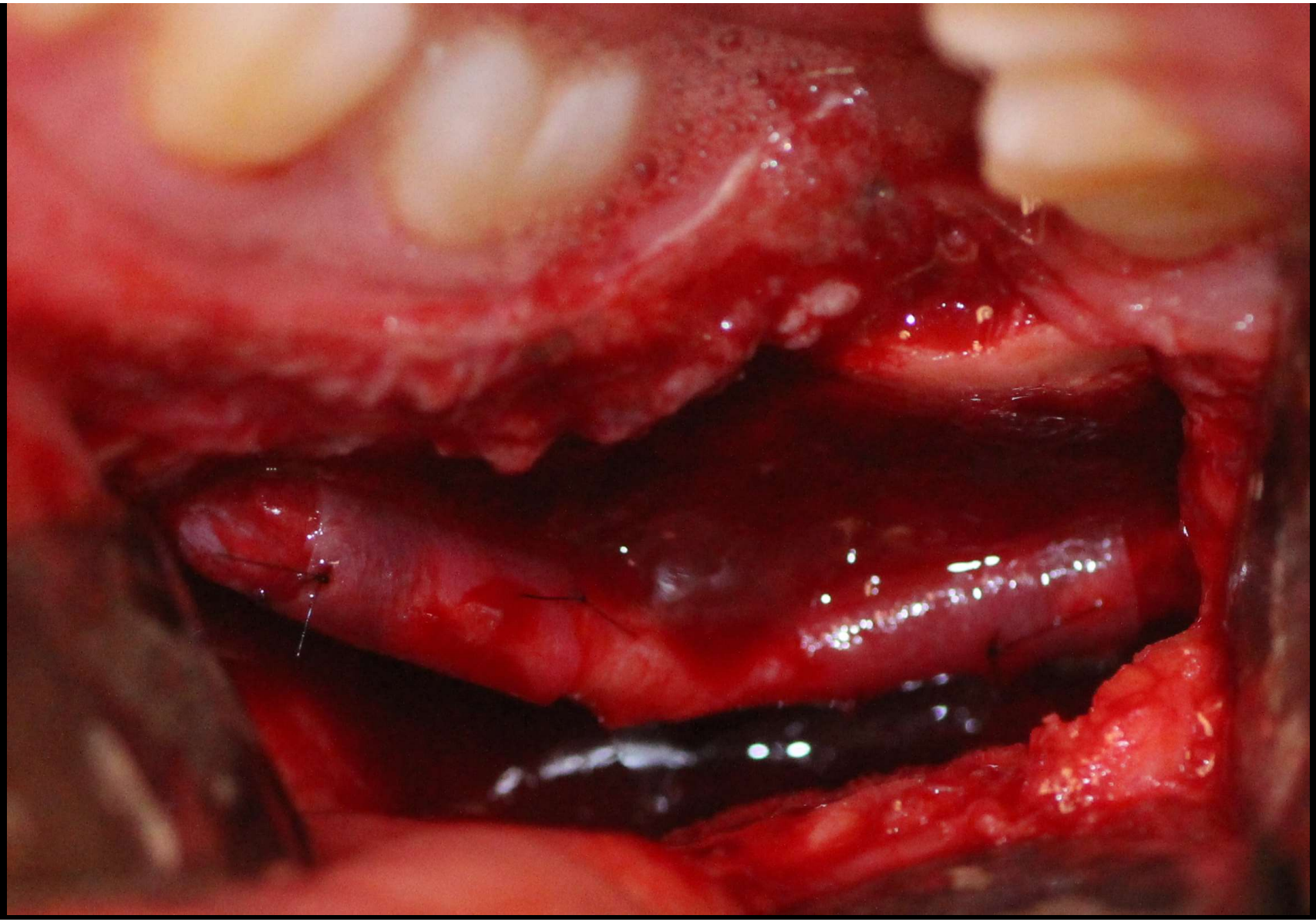

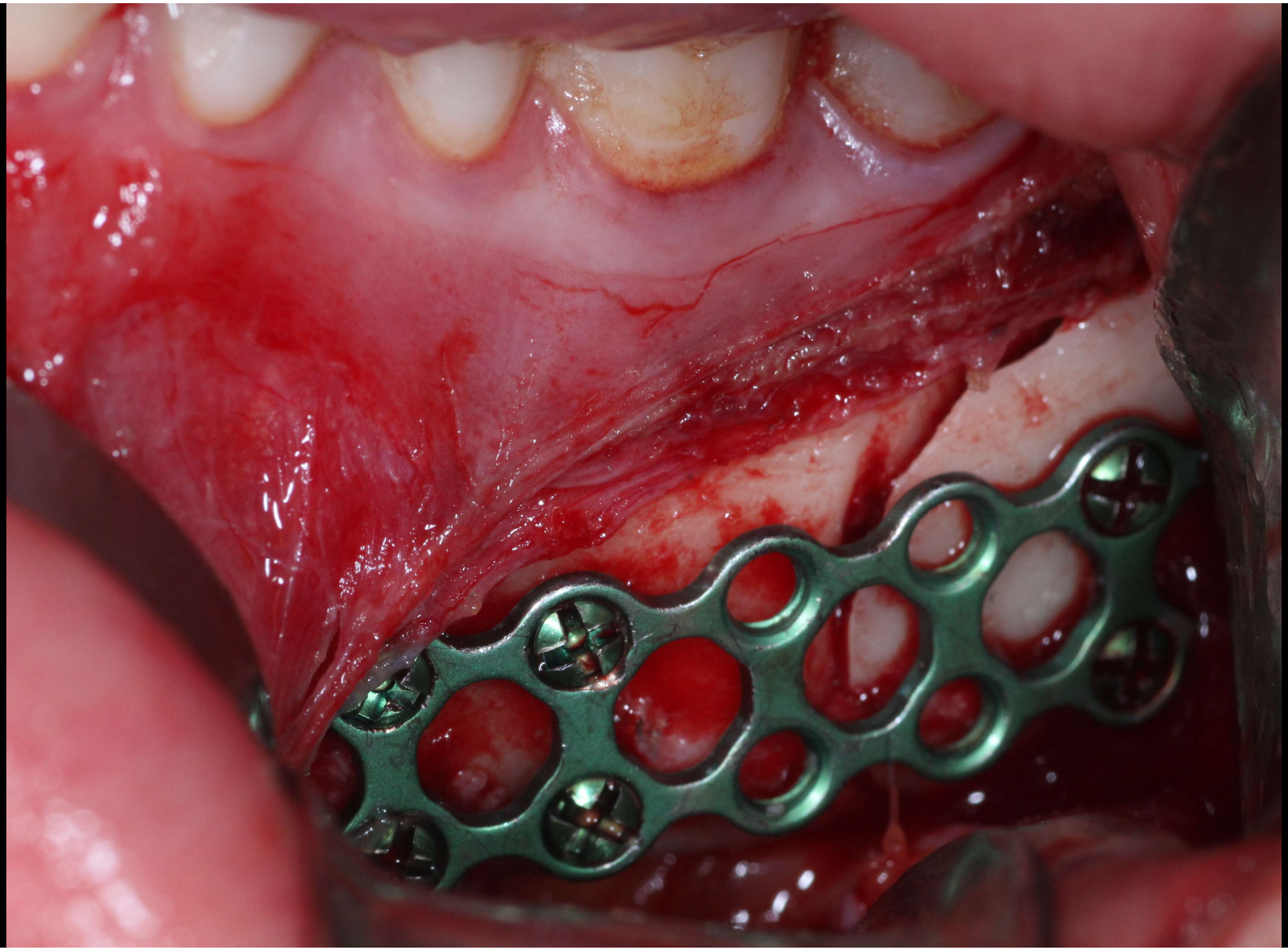

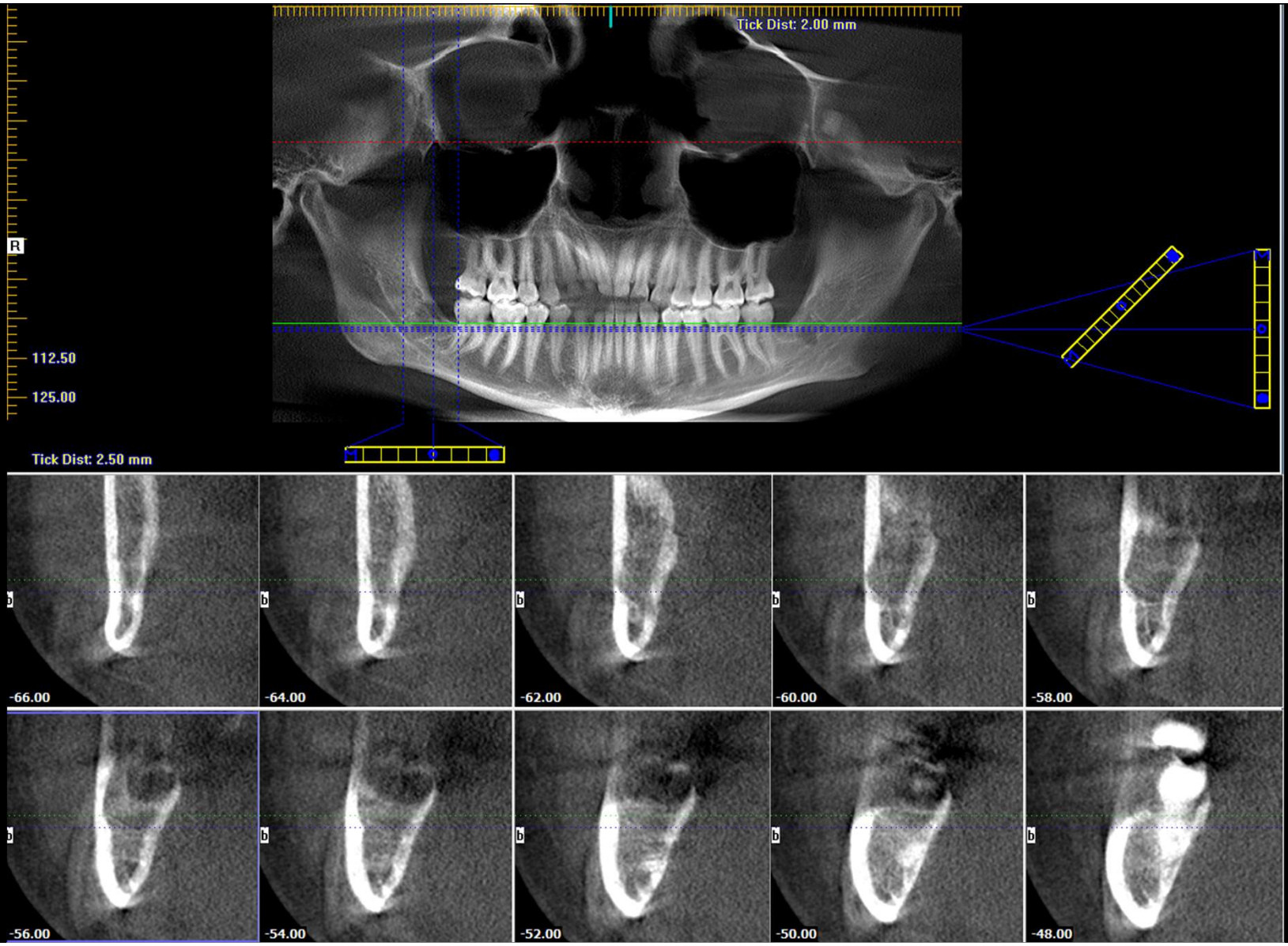
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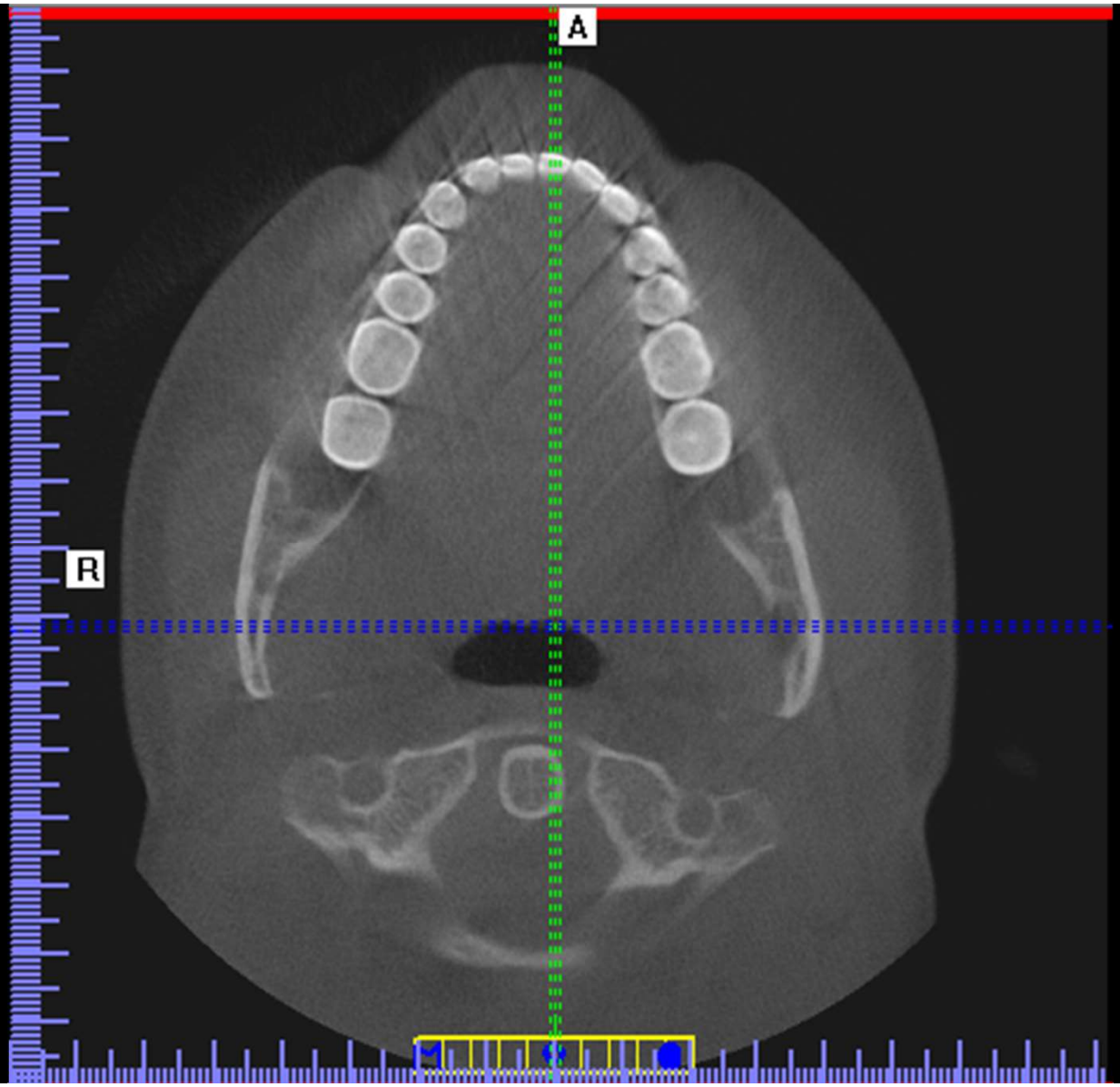
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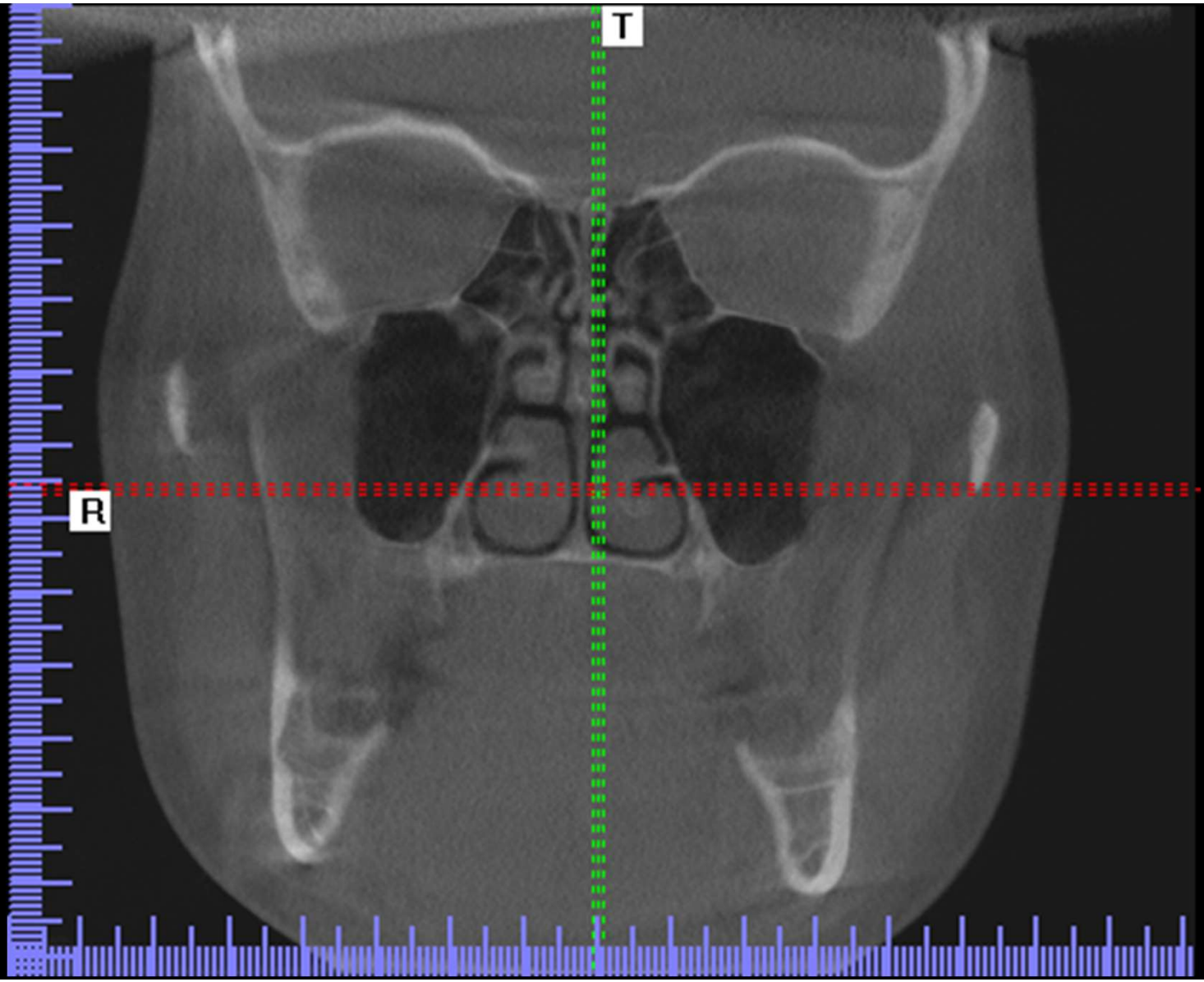
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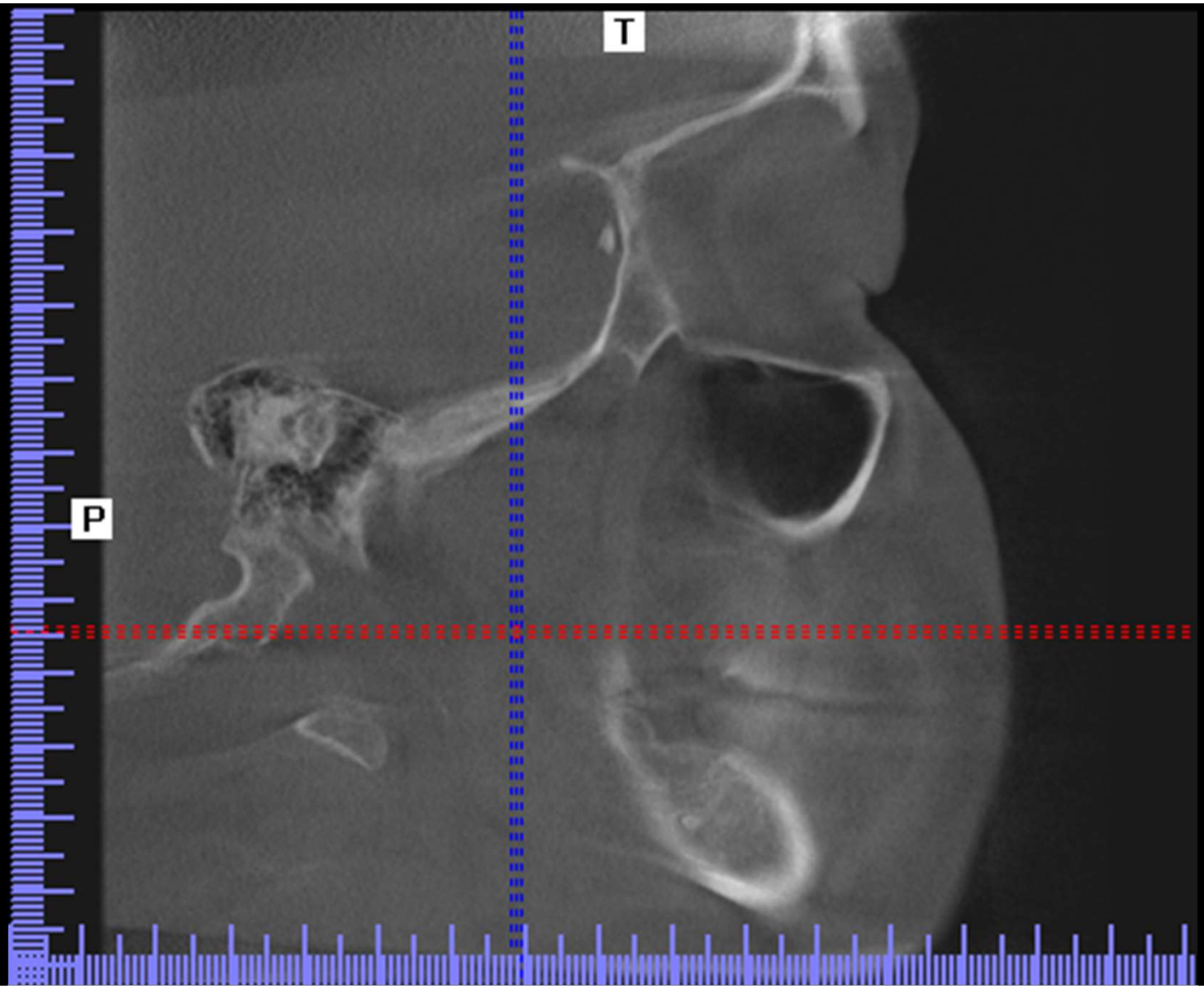
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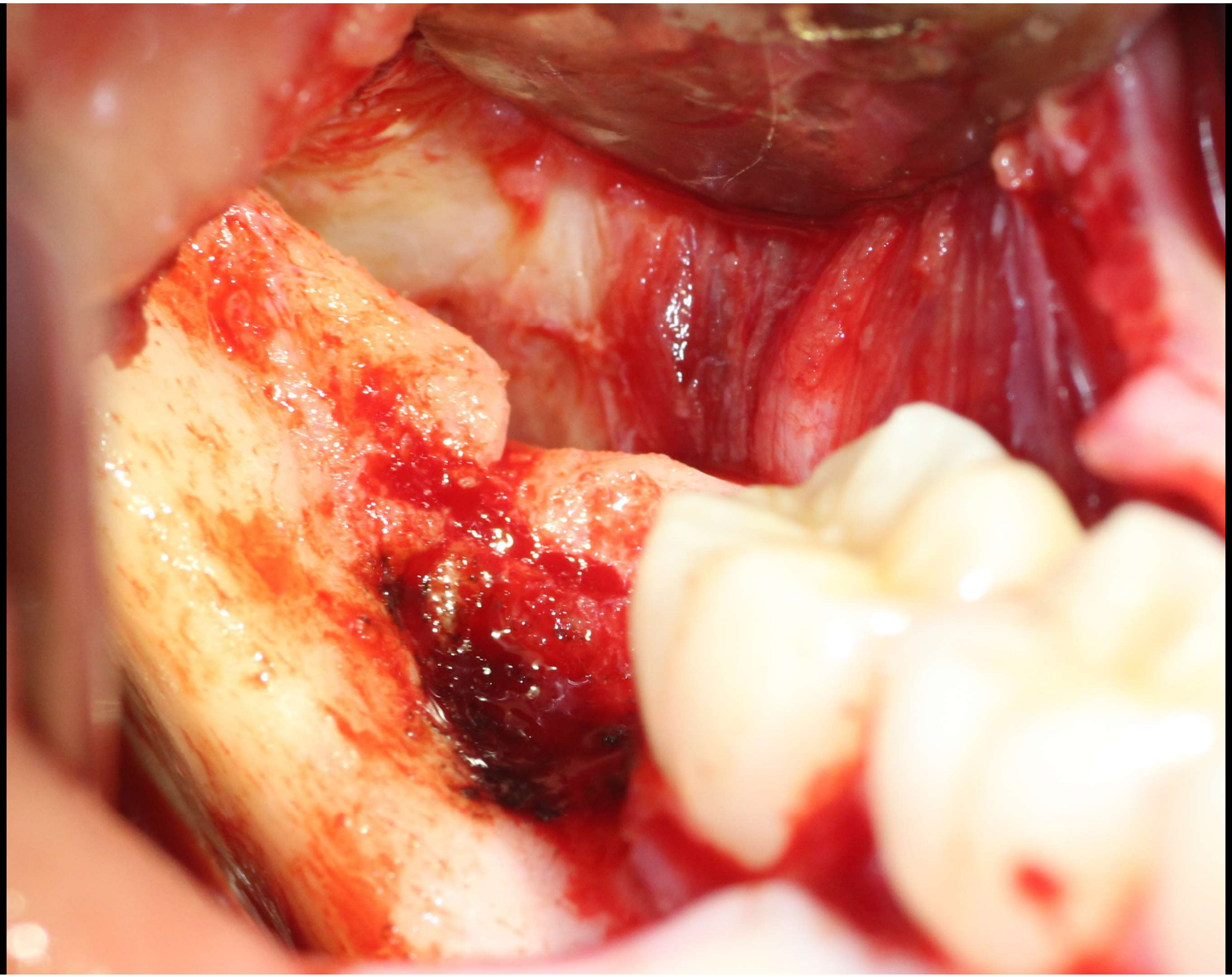

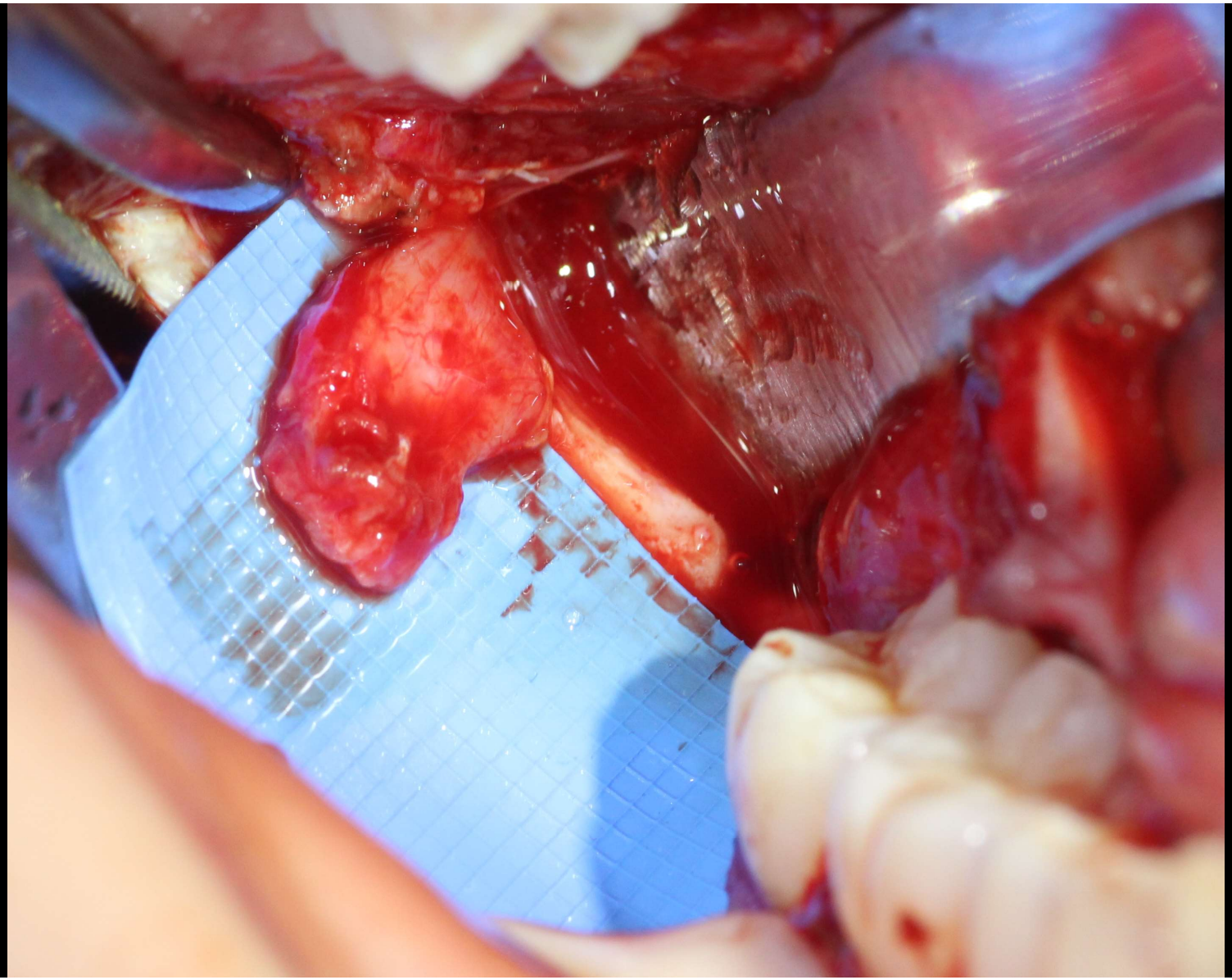

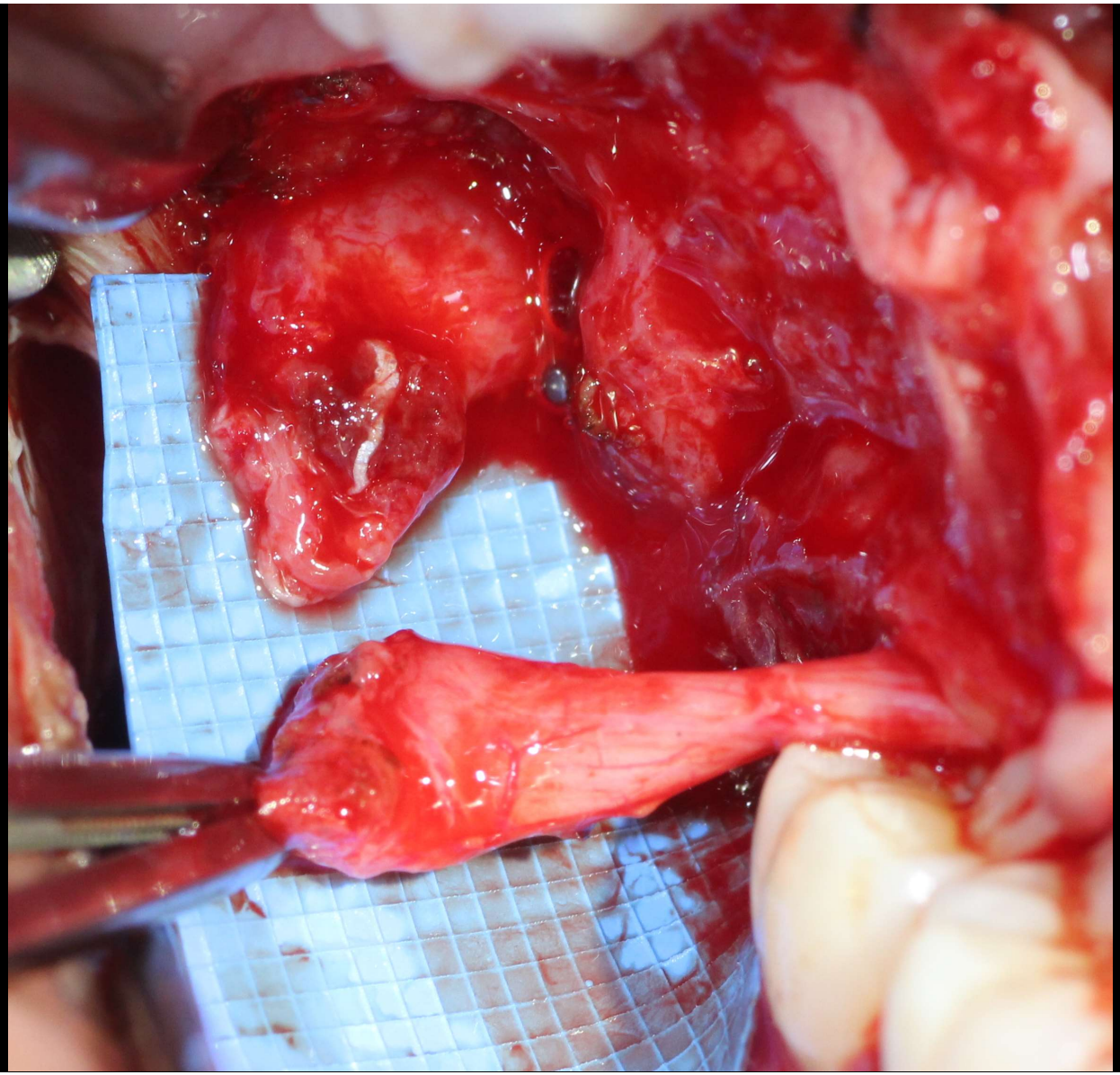

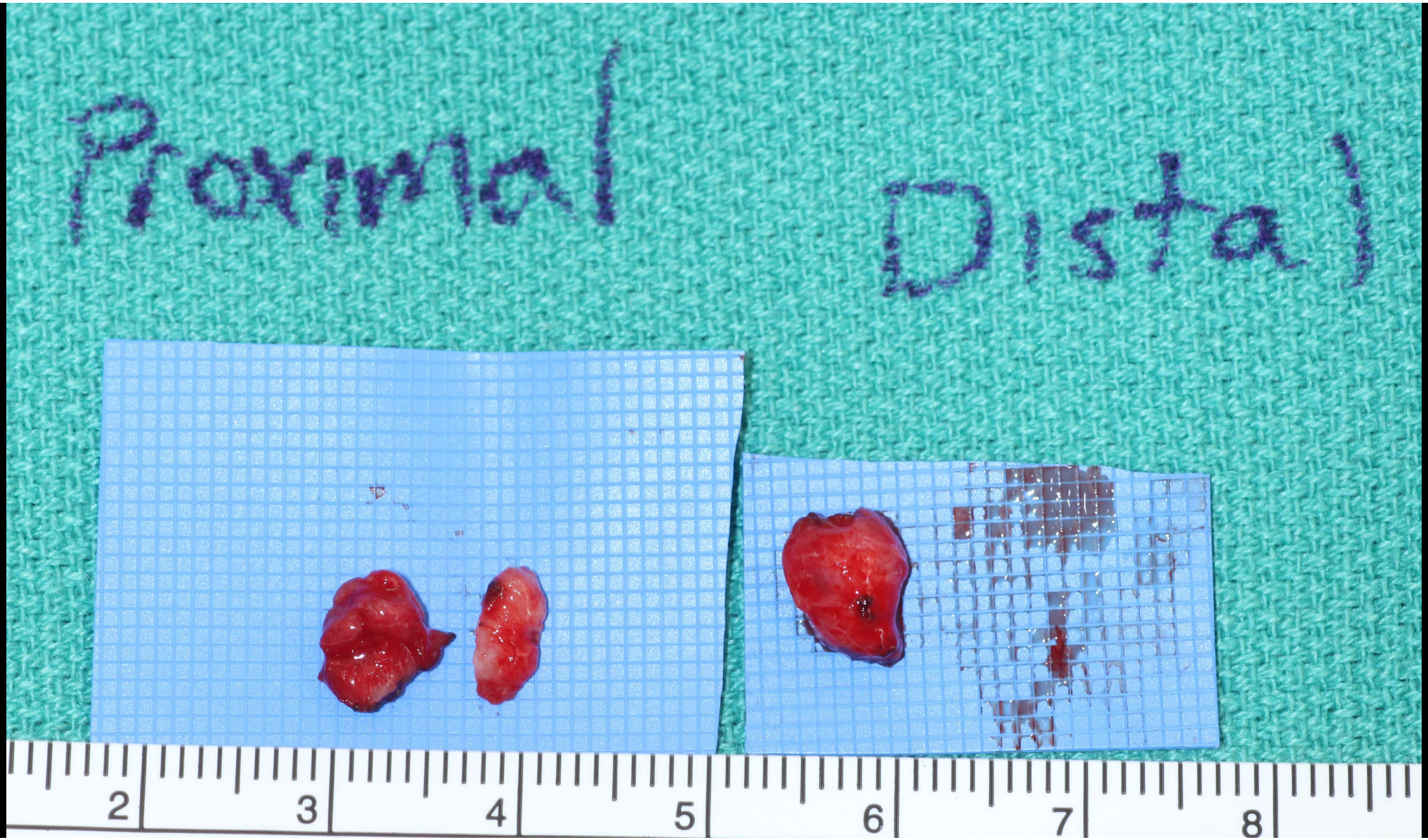
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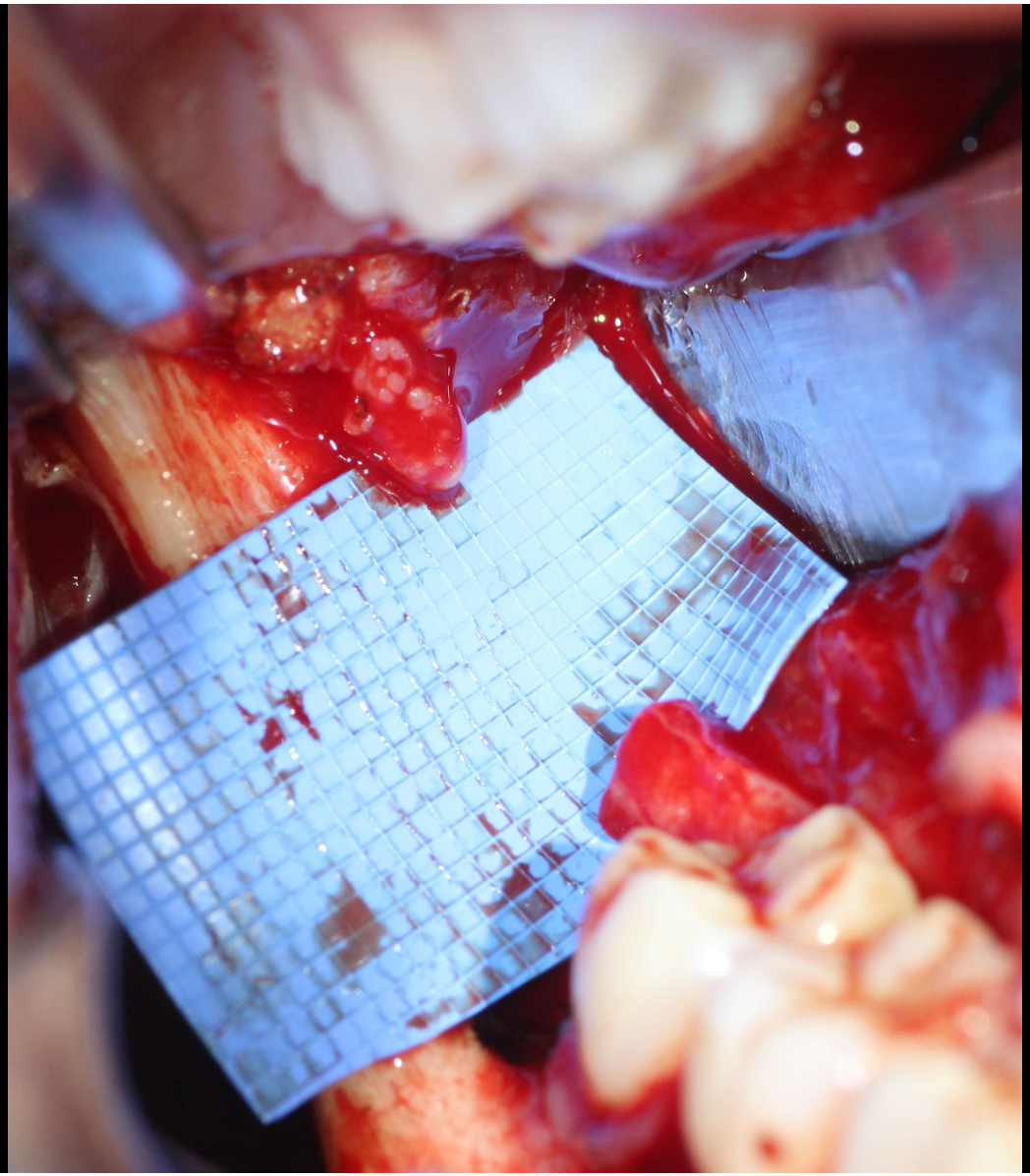


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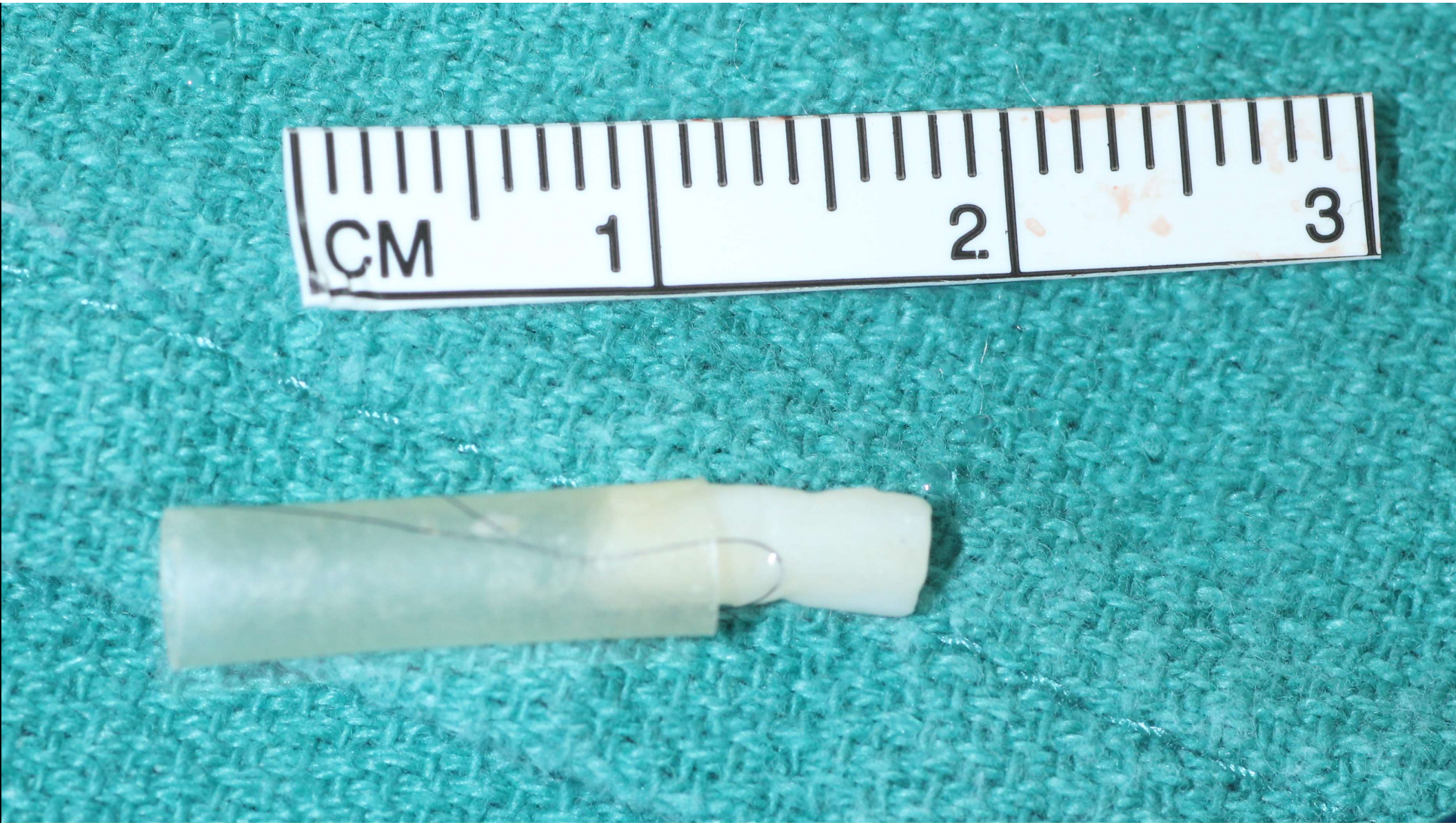
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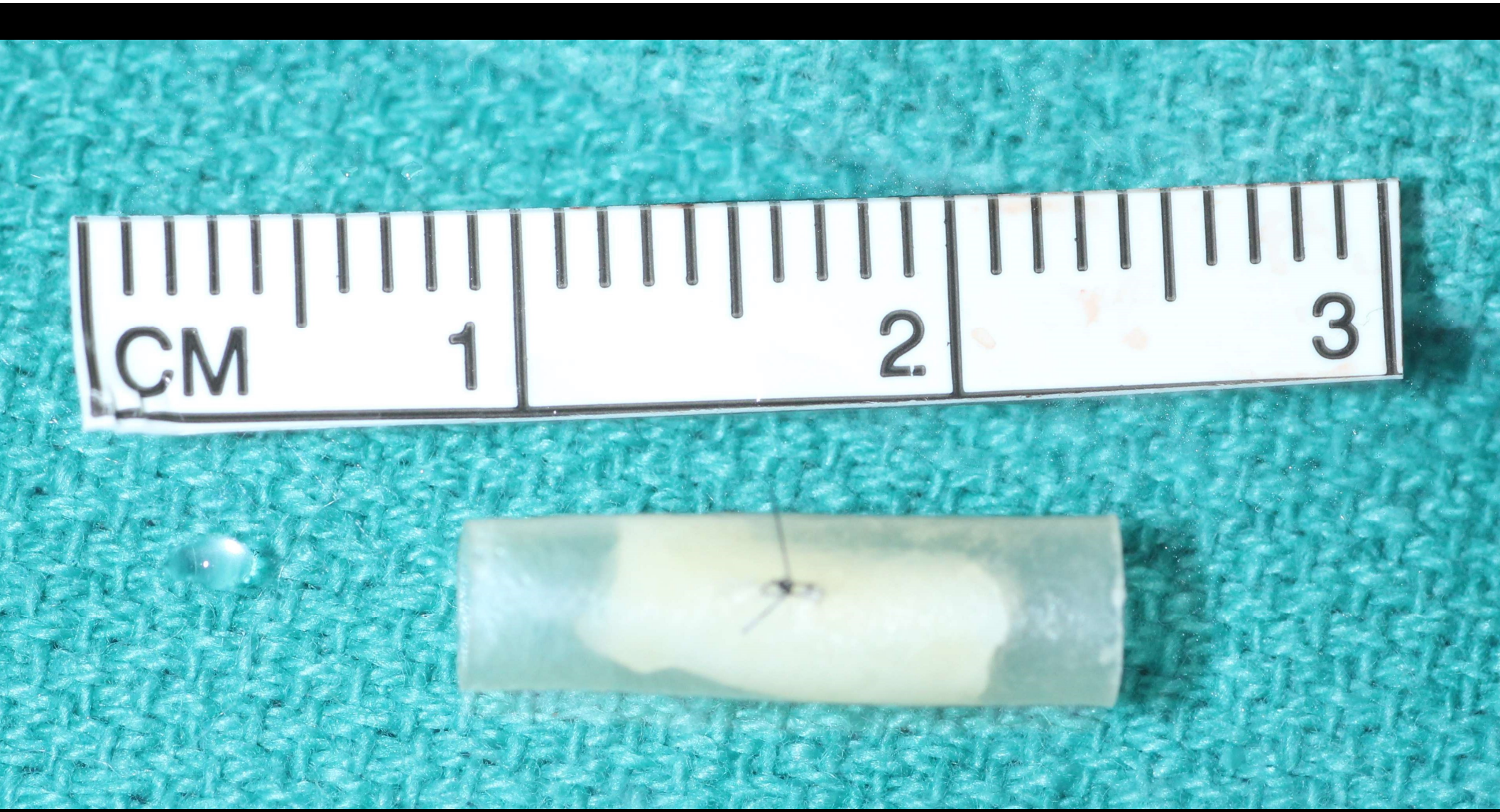
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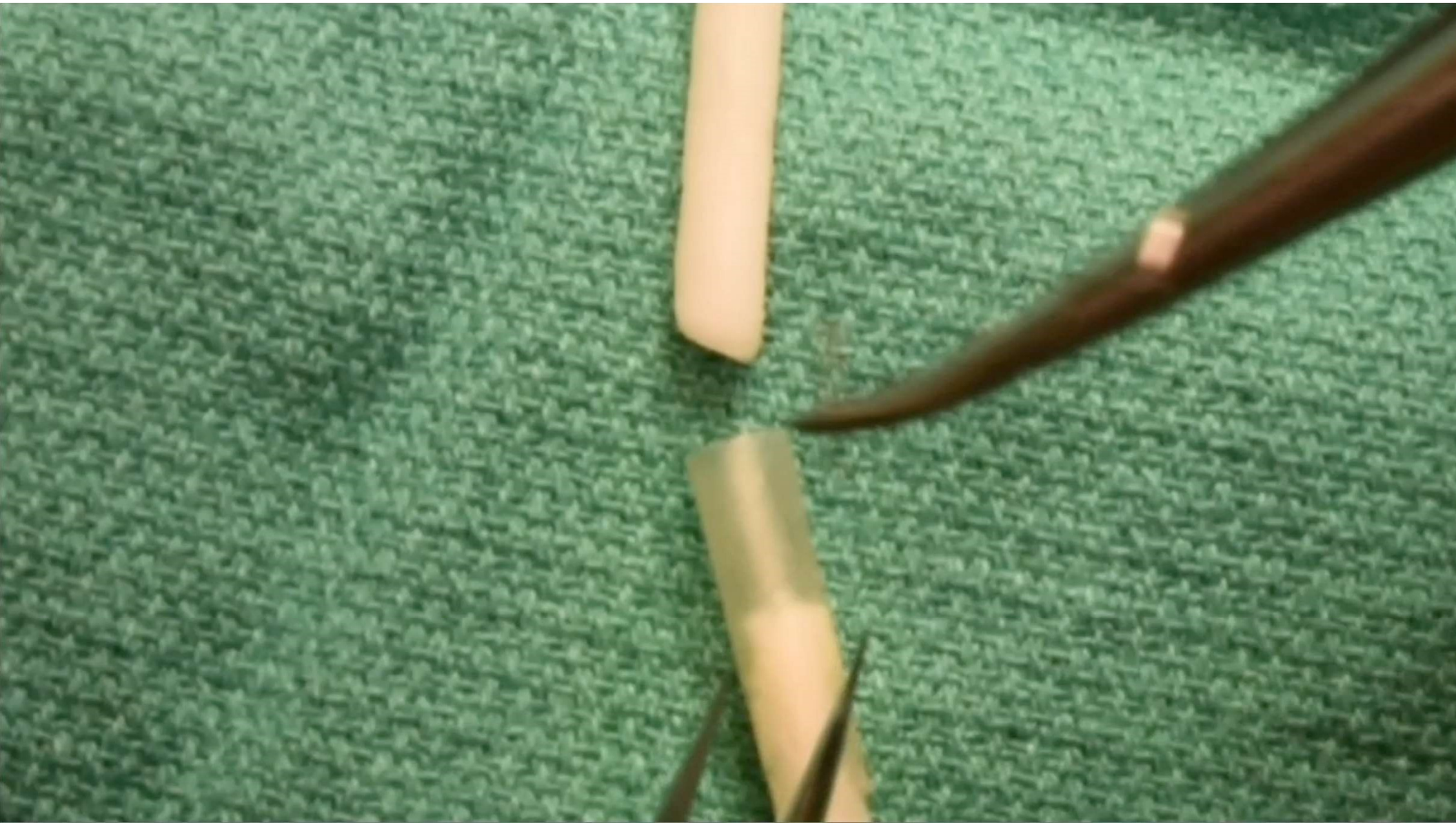

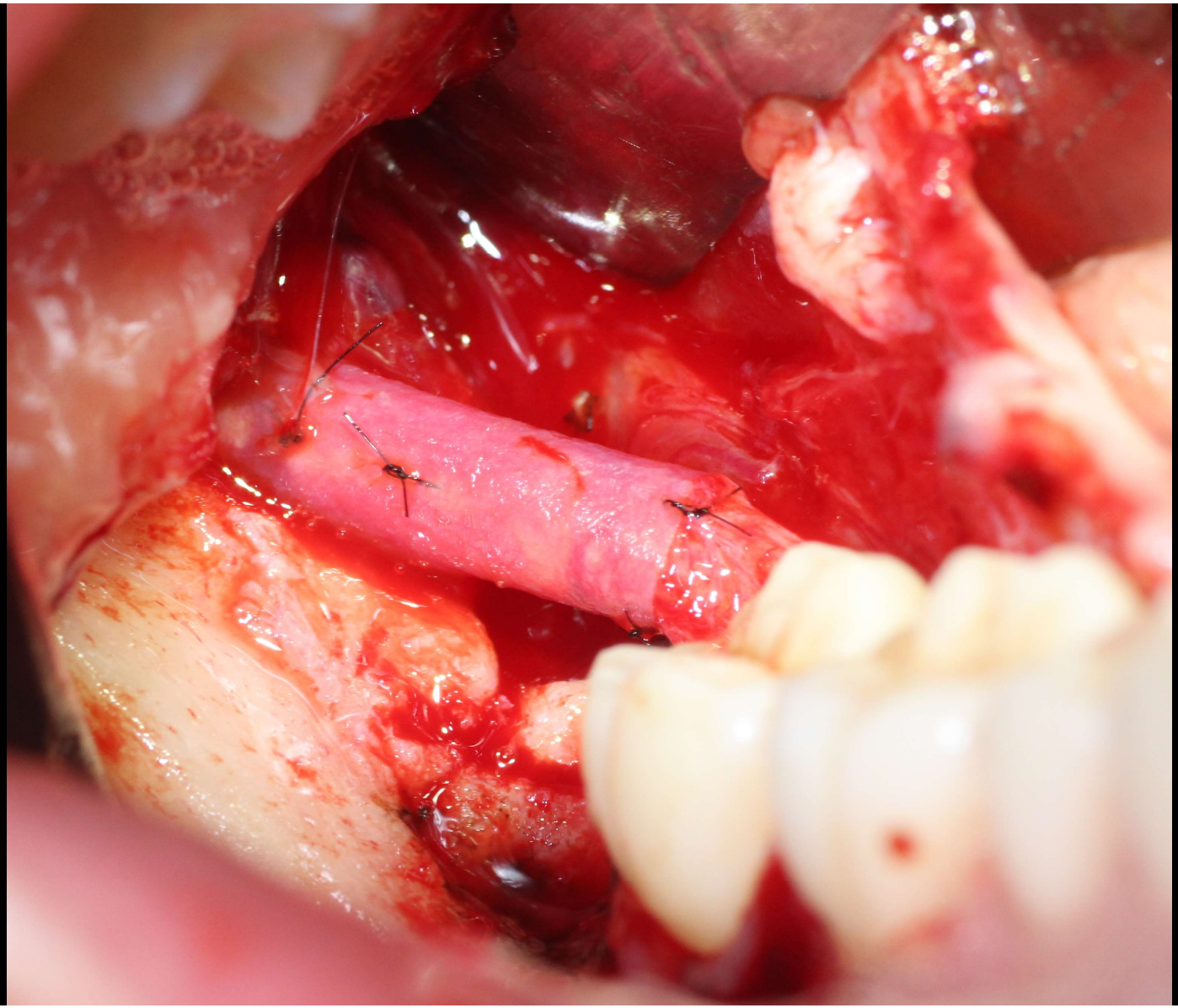

Neuroregeneration

Regeneration

Axonal regeneration occurs from the most distal node of Ranvier. As many as 50–100 nodal sprouts appear, mature into a growth cone, and elongate responding to directing signals from local tissue and deinervated motor and sensory receptors.

D. Grinsell and C. P. Keating, “Peripheral Nerve Reconstruction after Injury: A Review of Clinical and Experimental Therapies,” BioMed Research International, vol. 2014, Article ID 698256, 13 pages, 2014. doi:10.1155/2014/698256

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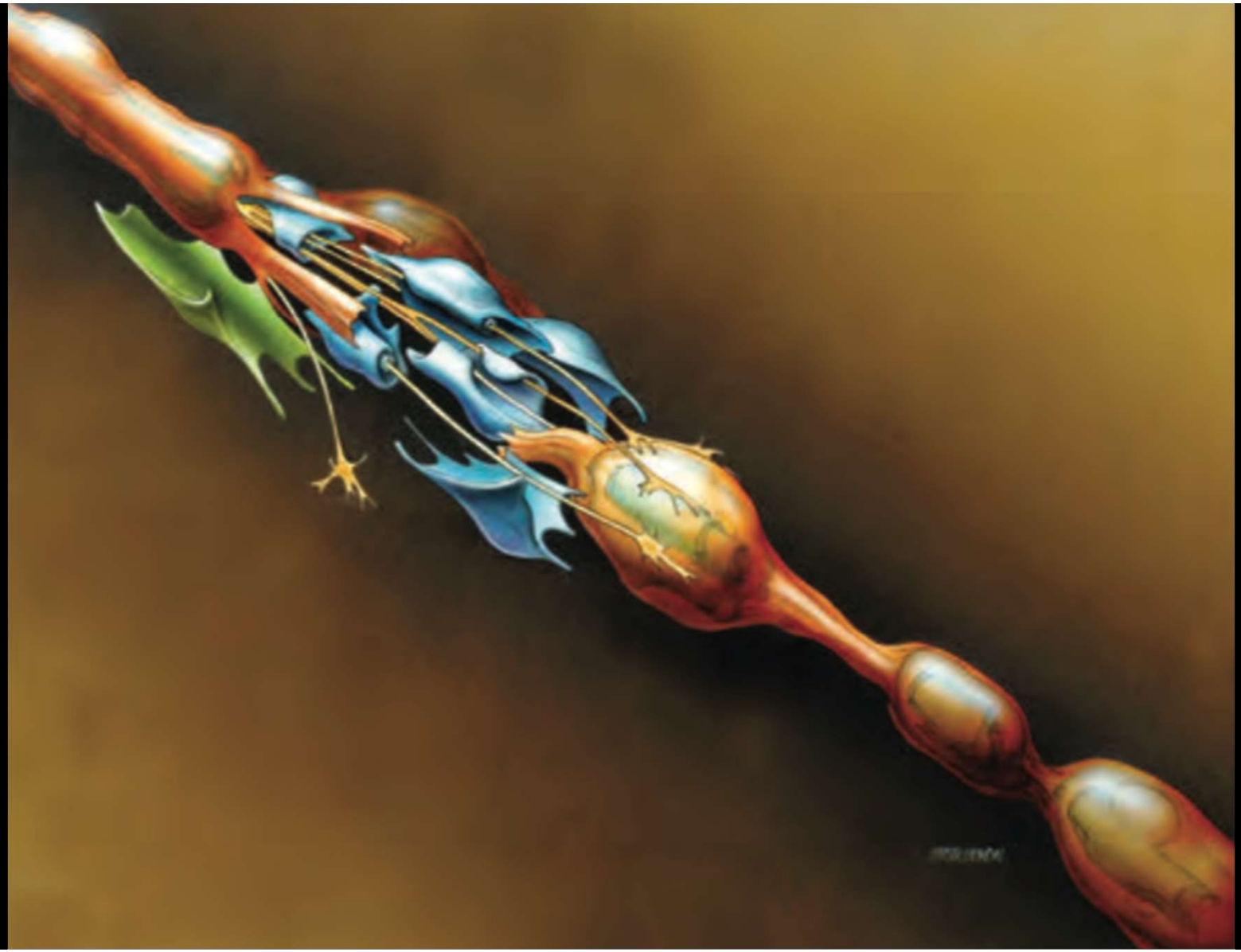

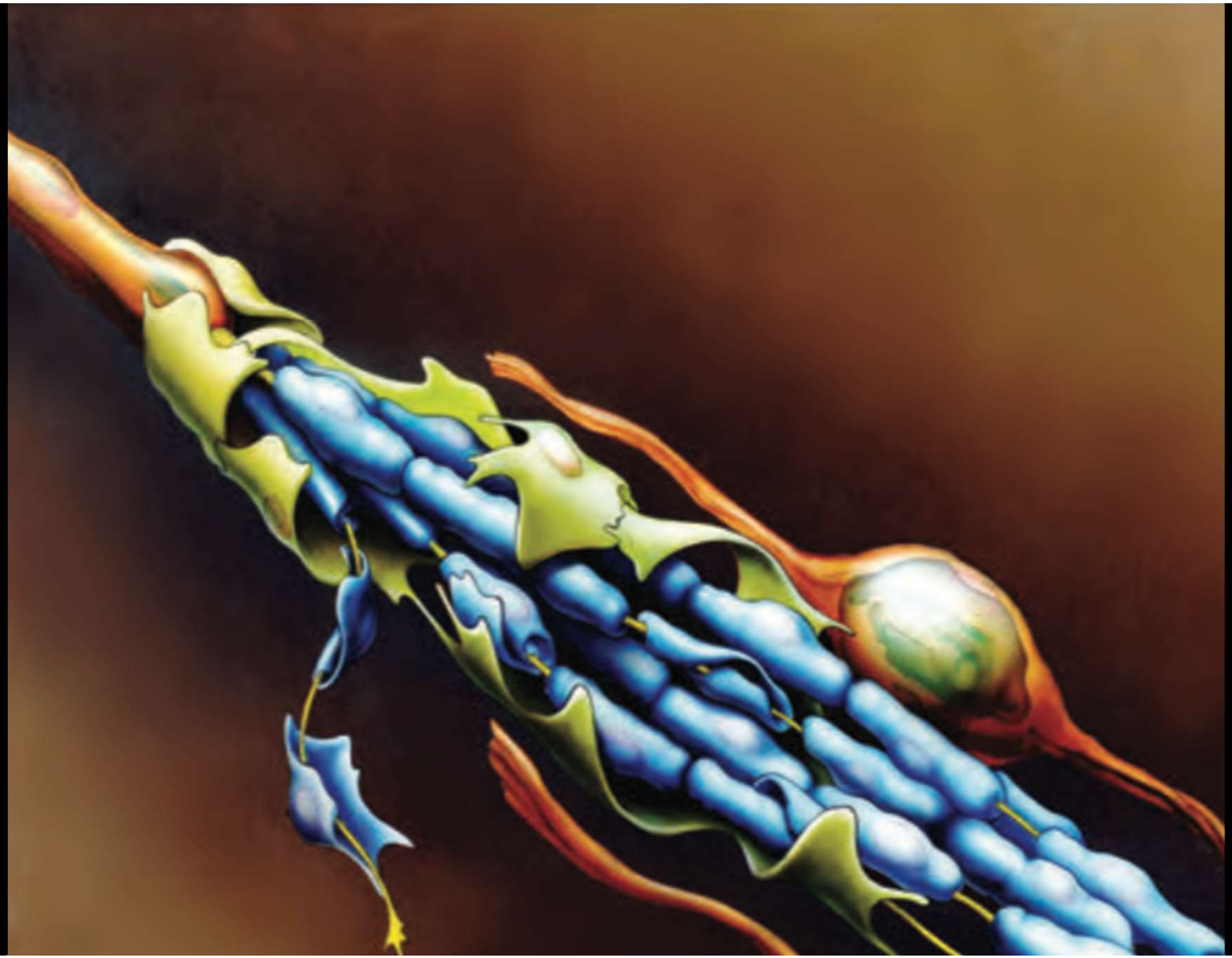

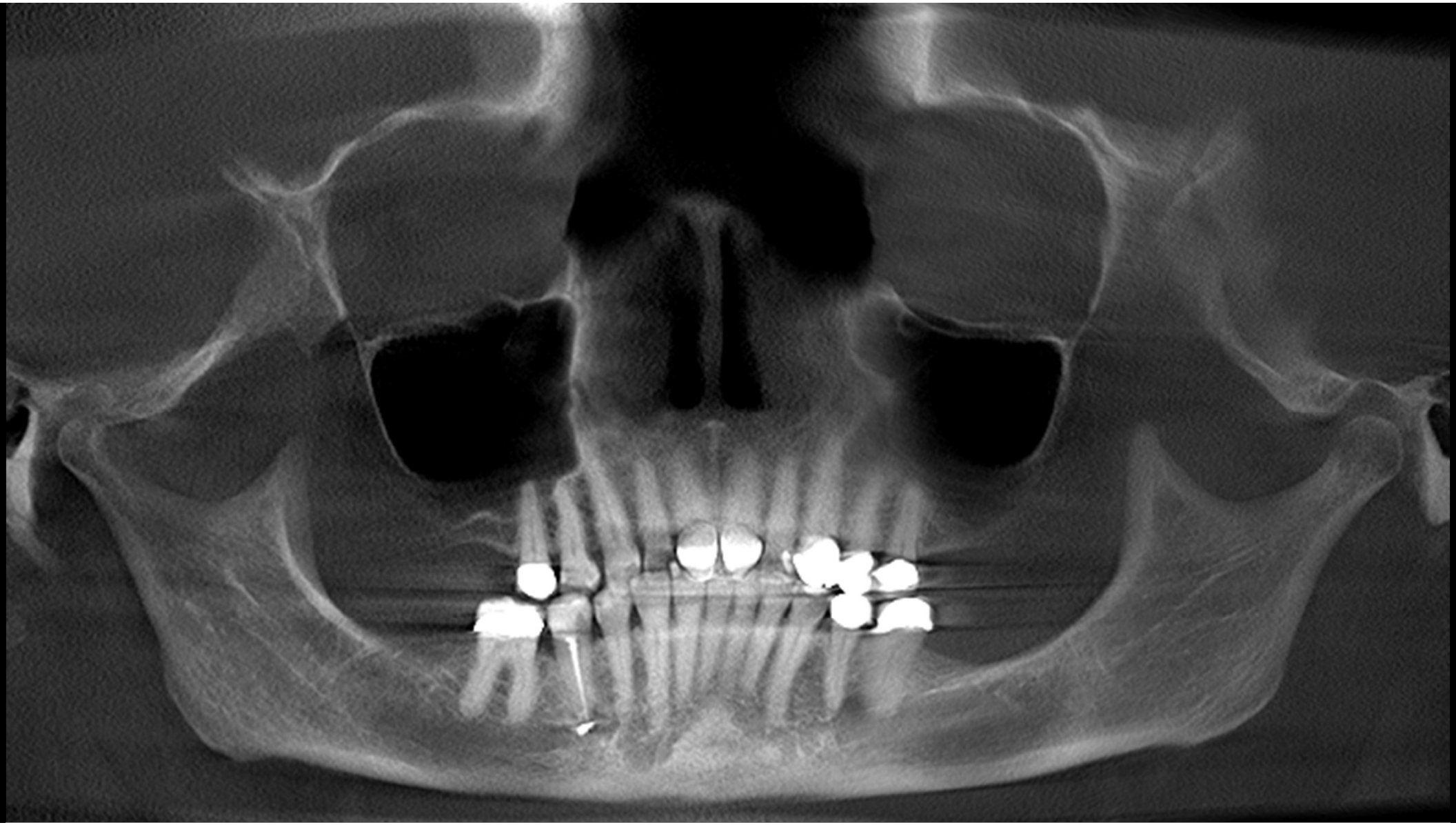

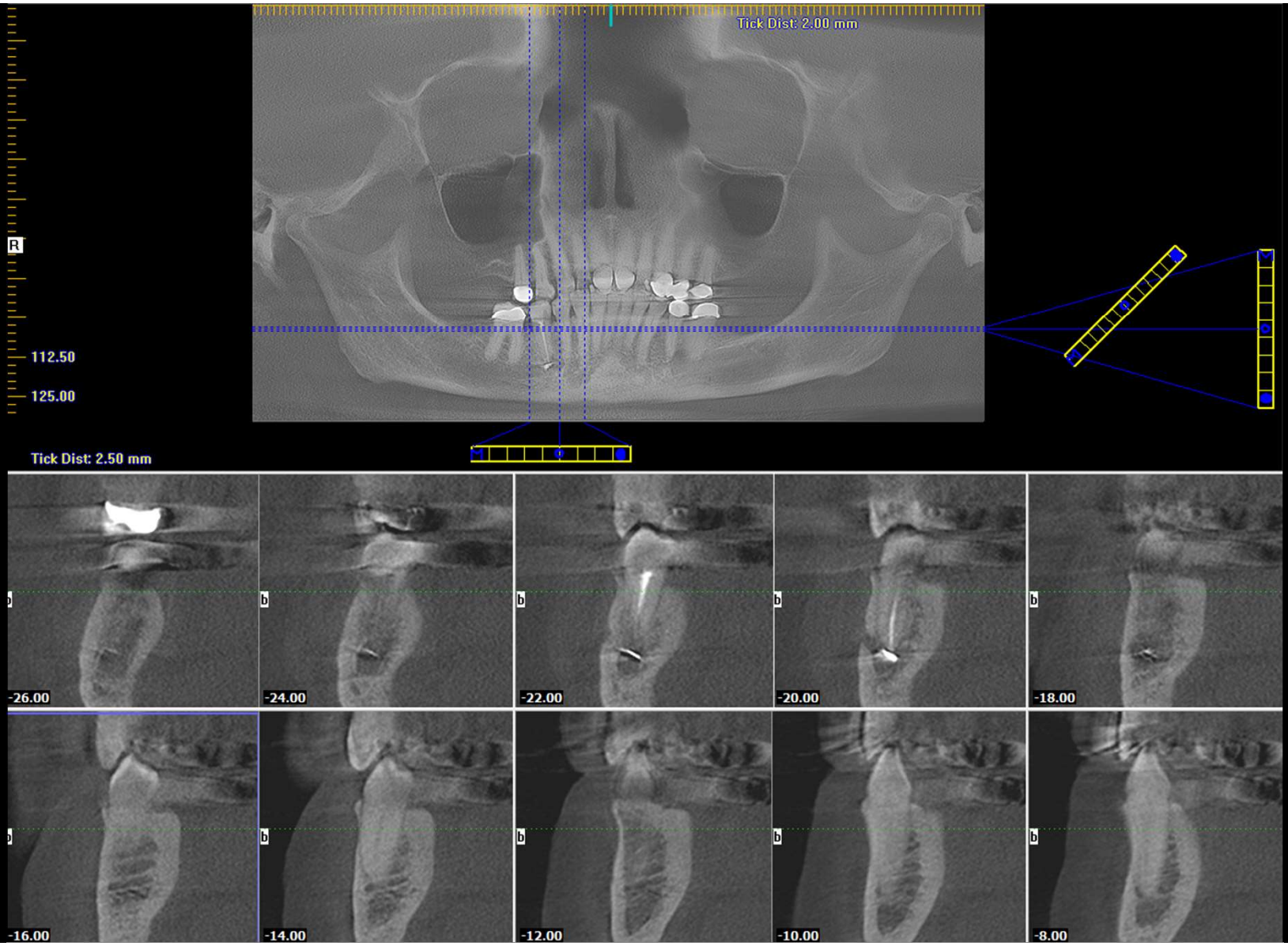
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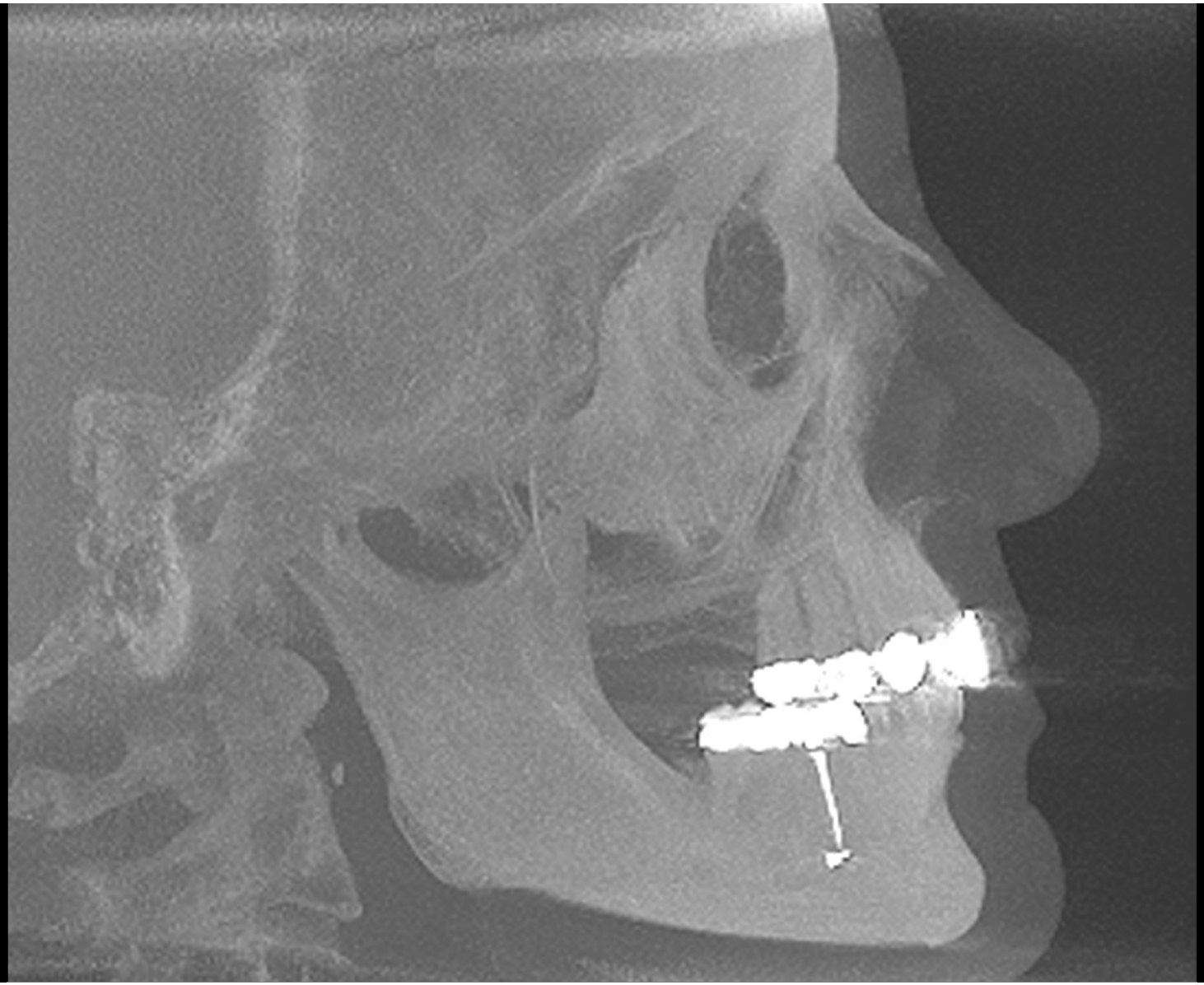

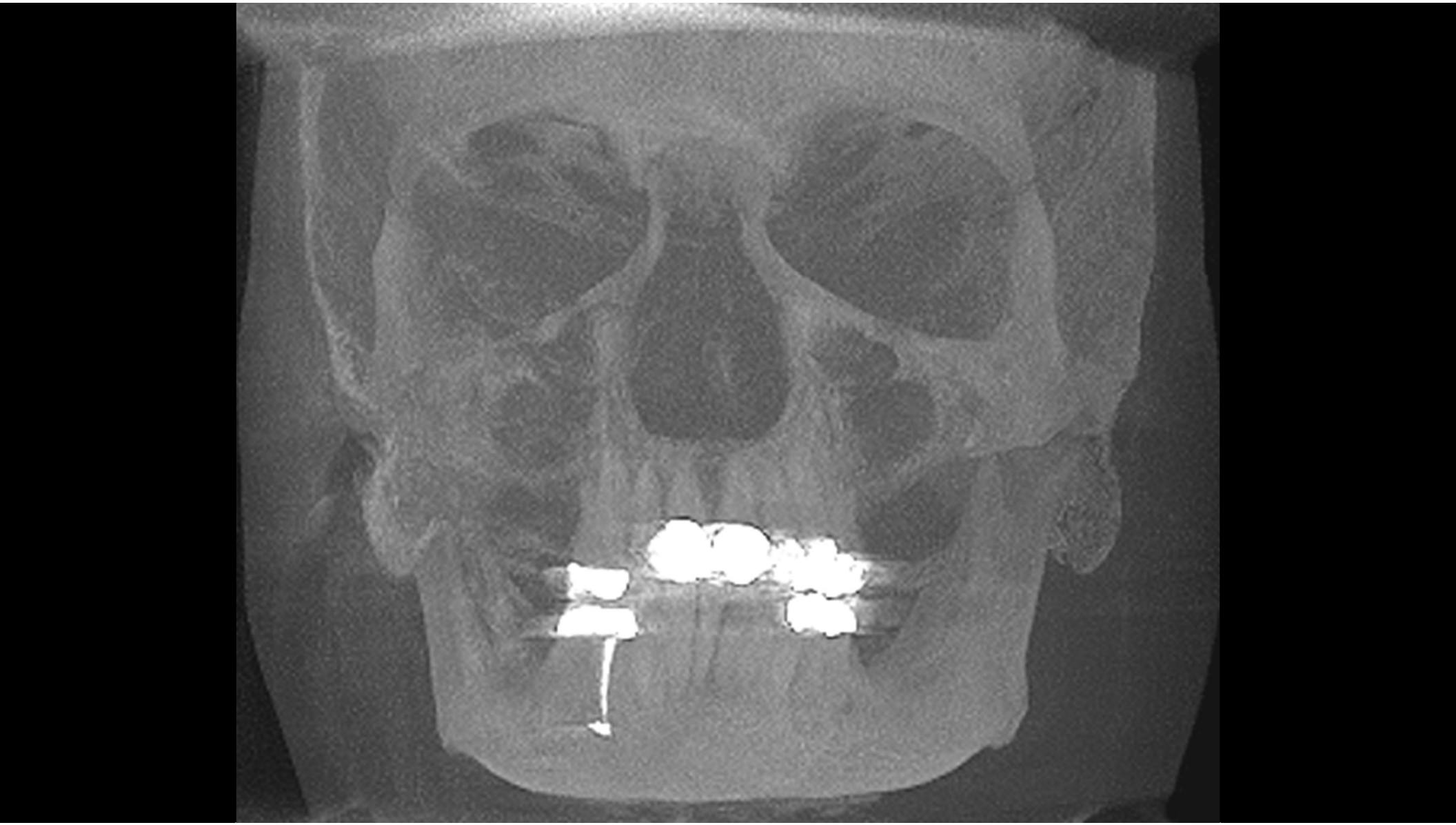

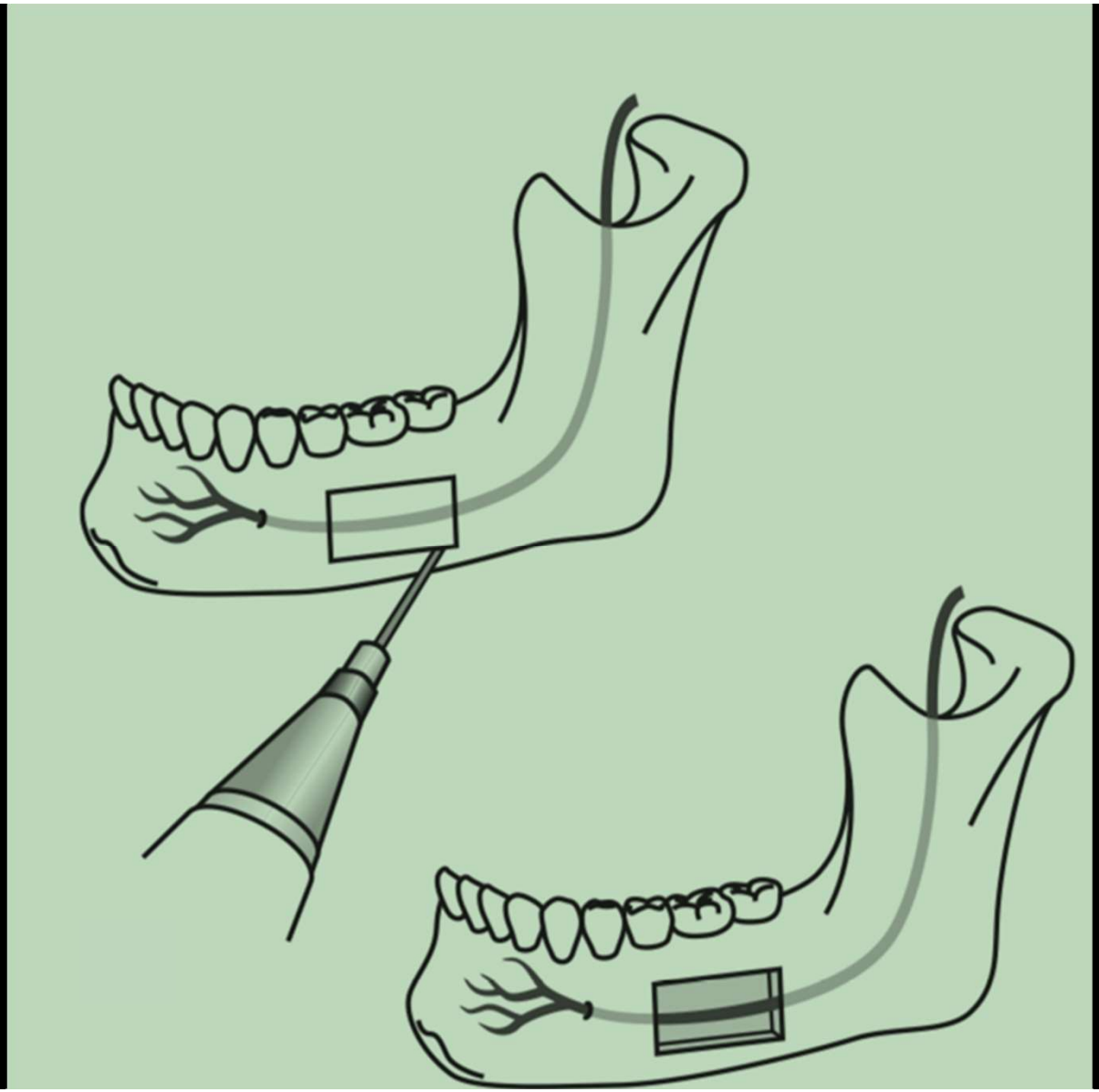

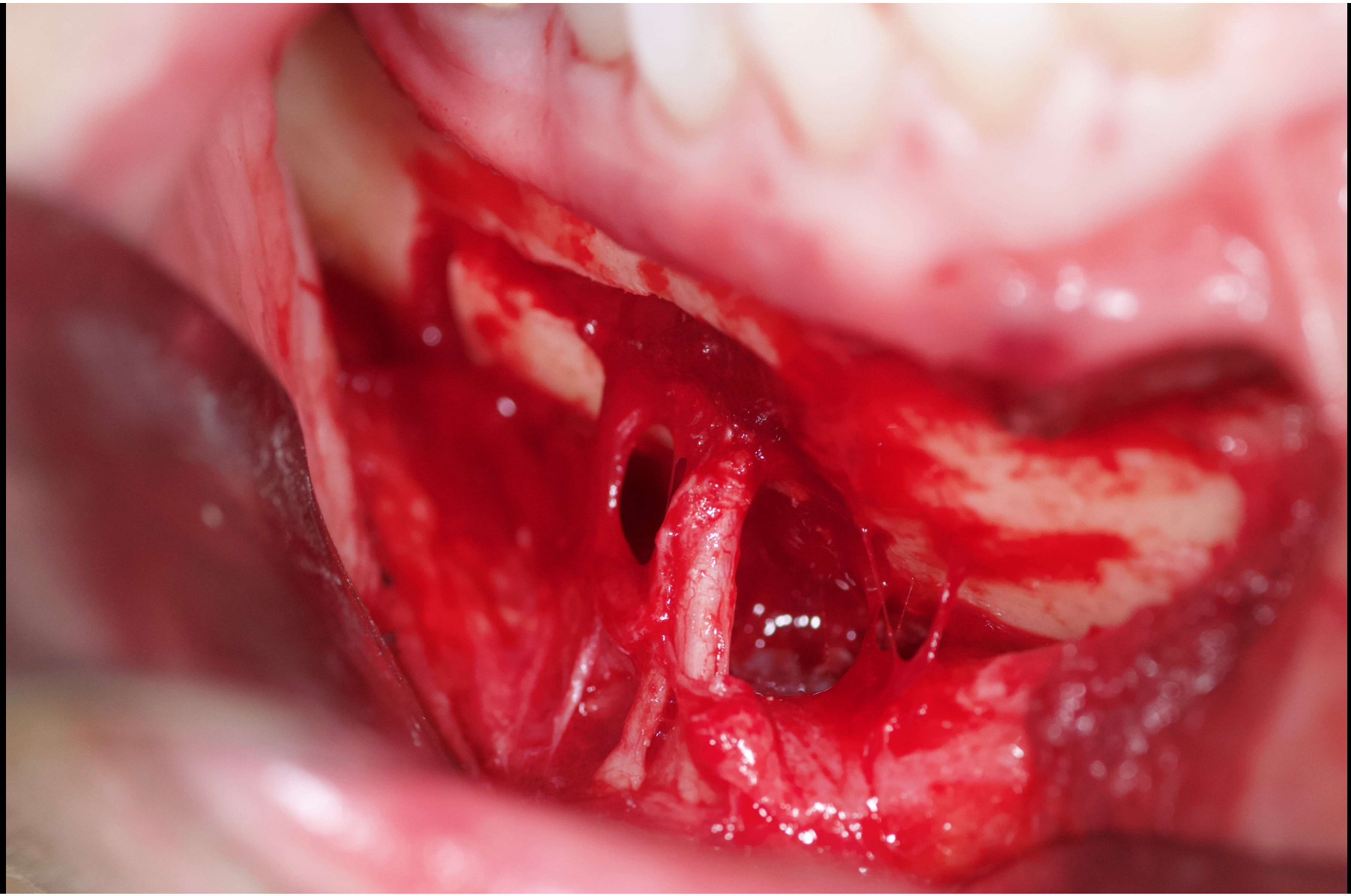

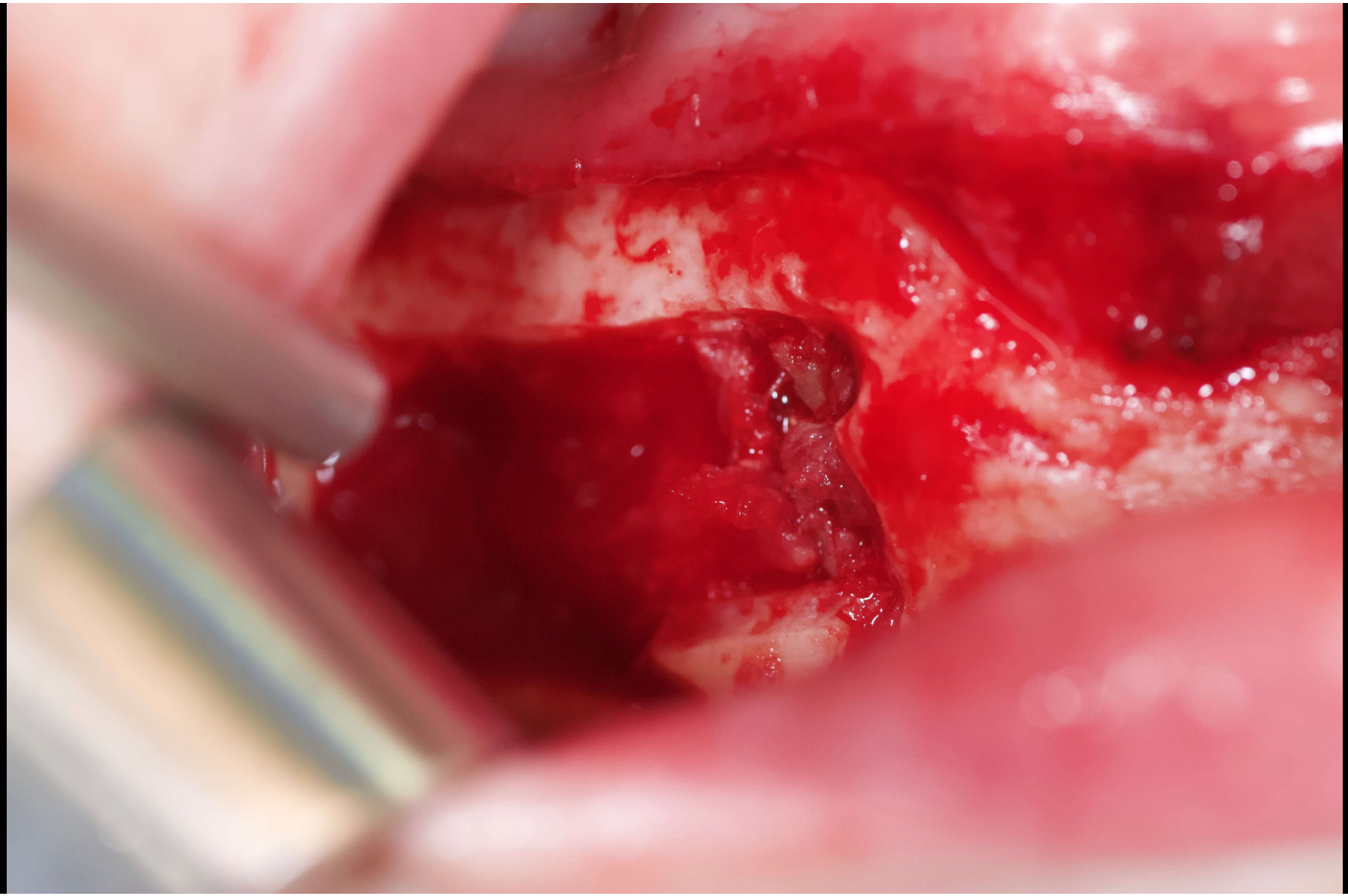

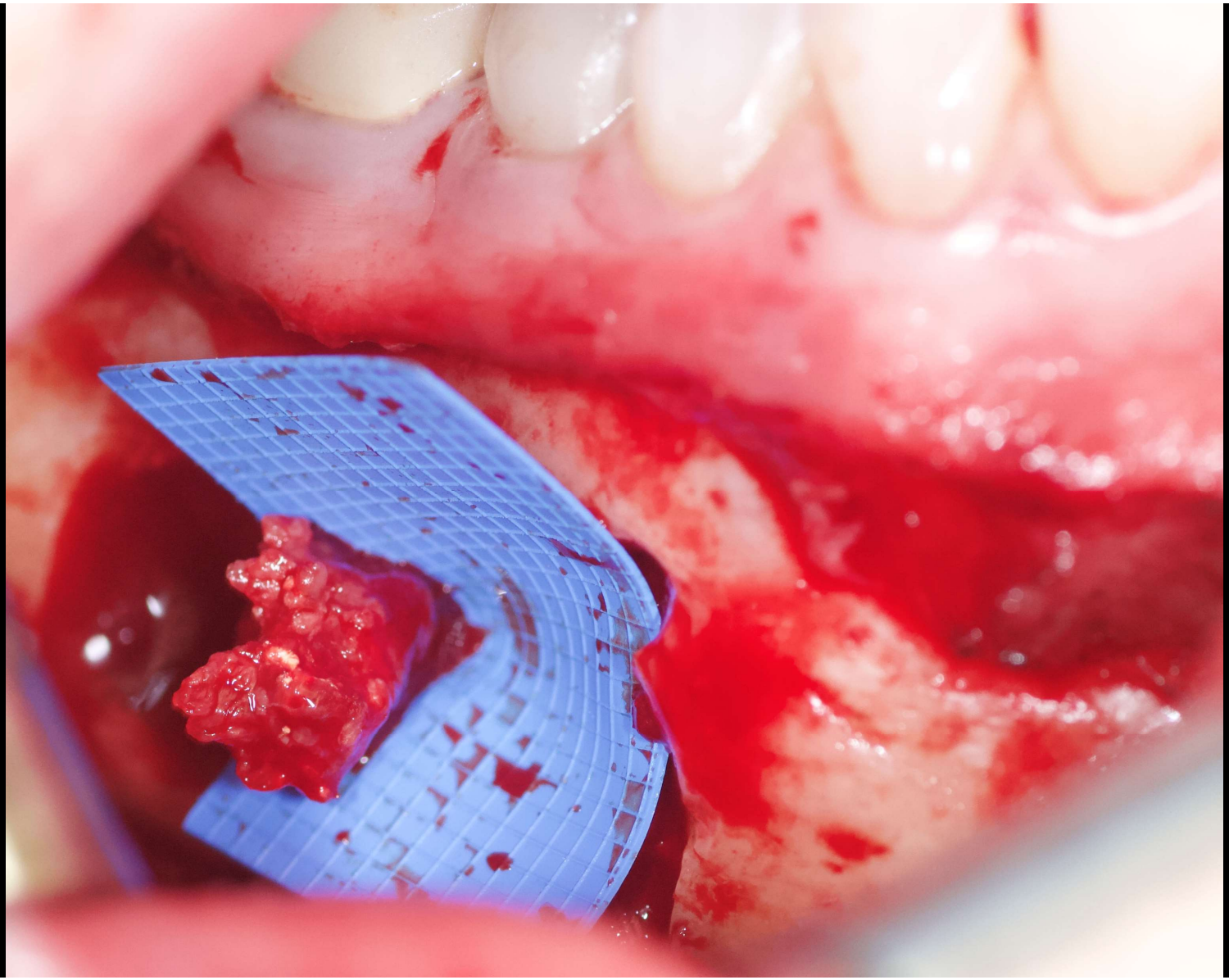

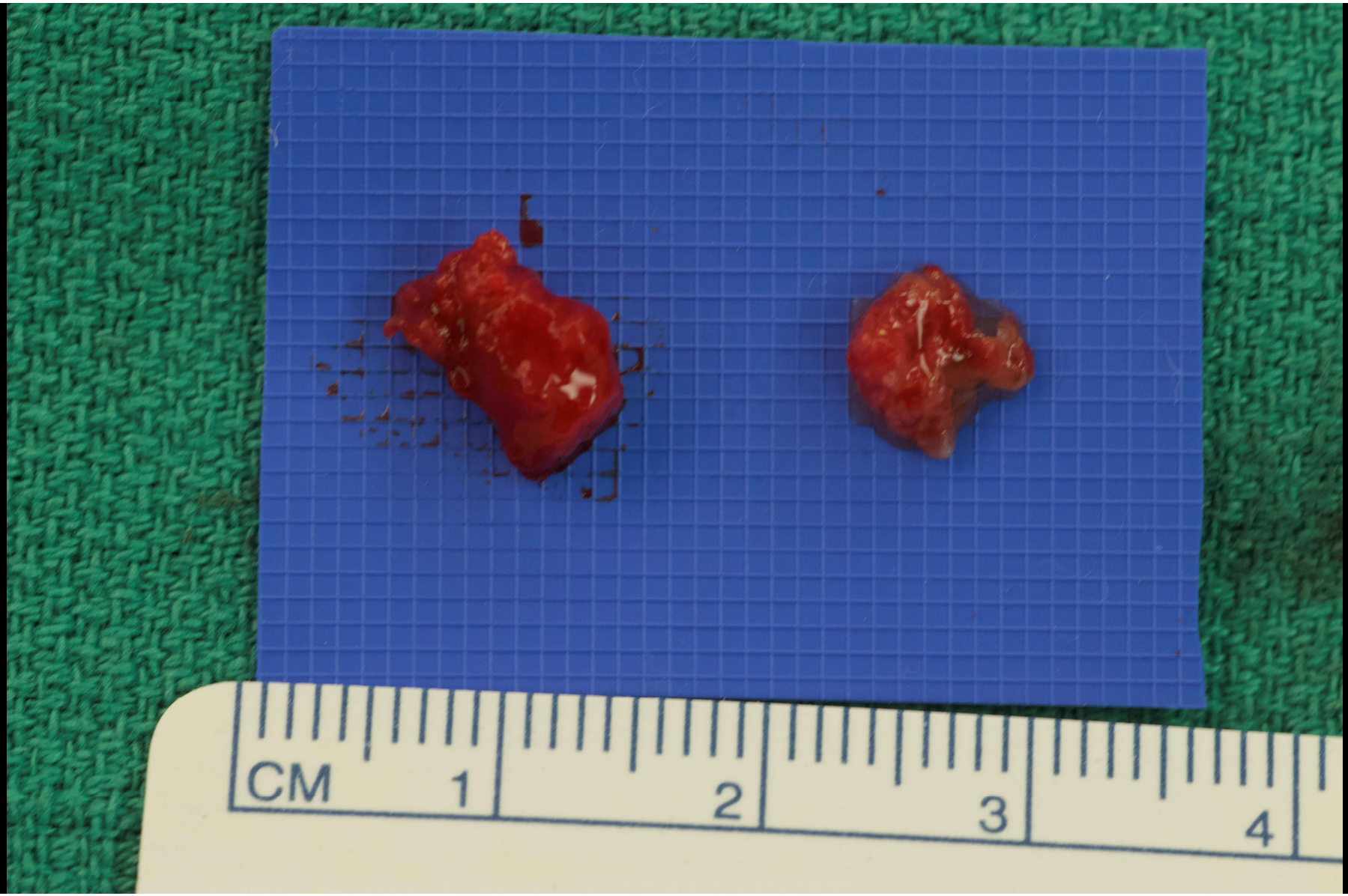
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Nerve allografts and conduits

Conduit

Highly purified type 1 collagen derived from bovine deep flexor tendons

Decellularized nerve allografts

Harvest from neck to lower extremities

Recovery of neurosensation

Conduits

Regeneration through conduits is achieved predominately through a fibrin cable formed between the proximal and distal nerve stumps. Results begin to decline at gaps greater than 5 mm.

Regeneration through an Allograft

The nerve allograft after processing provides mechanical guidance creating a supportive structure for the ingrowing axons. Nerve allografts stimulate a scaffold including Schwann cell basal laminae, neurotrophic factors, and adhesion molecules.

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Recovery of neurosensation

Allografts

Processed nerve allografts have been shown to be clinically effective and safe for peripheral nerve discontinuities from 5 to 50 mm.

PROCESSED NERVE ALLOGRAFTS FOR PERIPHERAL NERVE RECONSTRUCTION: A MULTICENTER STUDY OF UTILIZATION AND OUTCOMES IN SENSORY, MIXED, AND MOTOR NERVE RECONSTRUCTIONS

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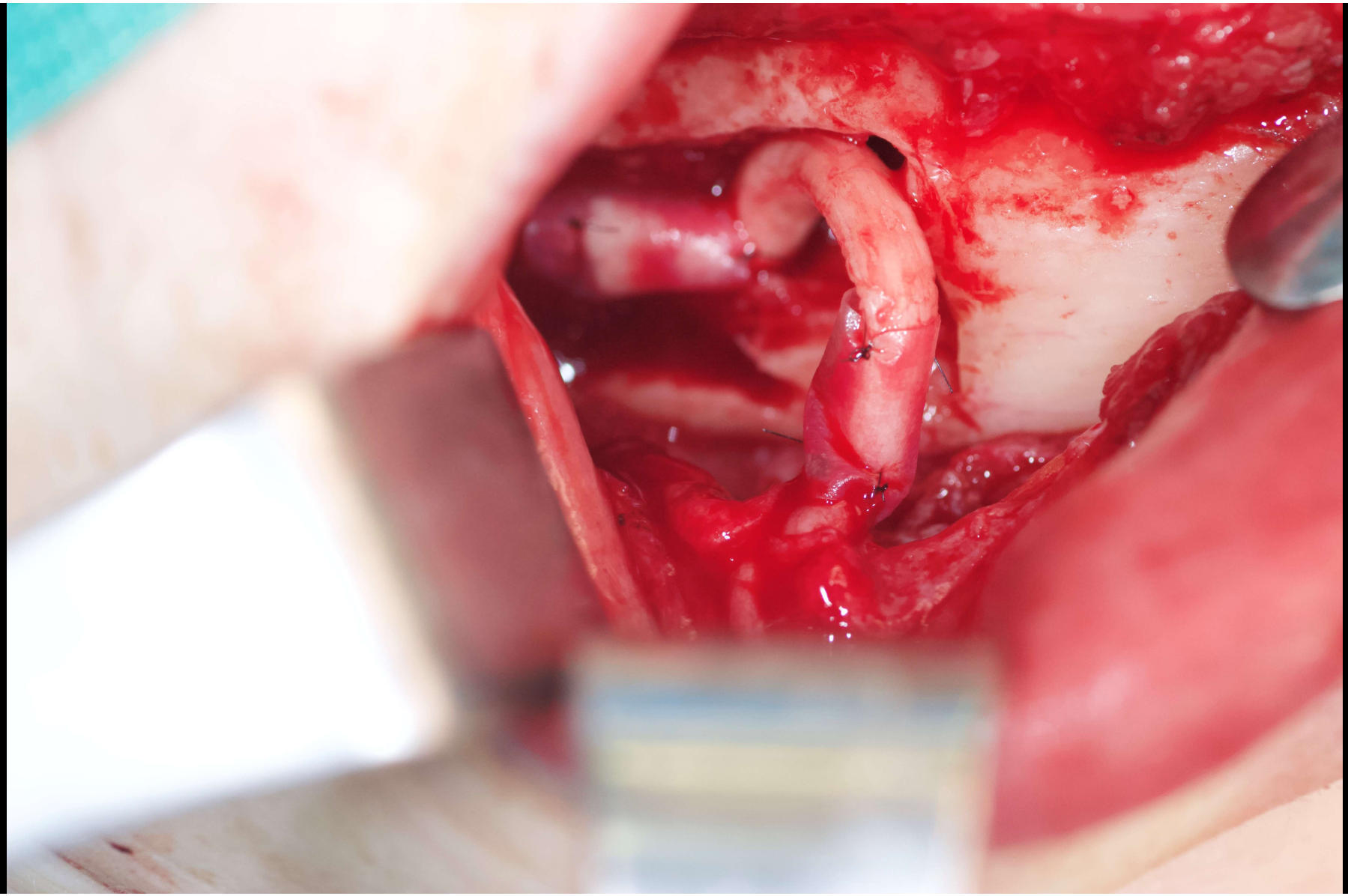

Sensory Outcomes After Reconstruction of Lingual and Inferior Alveolar Nerve Discontinuities Using Processed Nerve Allograft—A Case Series

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Purpose: The present study describes the results of using a processed nerve allograft, Avance Nerve Graft, as an extracellular matrix scaffold for the reconstruction of lingual nerve (LN) and inferior alveolar nerve (IAN) discontinuities.

Patients and Methods: A retrospective analysis of the neurosensory outcomes for 26 subjects with 28 LN and IAN discontinuities reconstructed with a processed nerve allograft was conducted to determine the treatment effectiveness and safety. Sensory assessments were conducted preoperatively and 3, 6, and 12 months after surgical reconstruction. The outcomes population, those with at least 6 months of postoperative follow-up, included 21 subjects with 23 nerve defects. The neurosensory assessments included brush stroke directional sensation, static 2-point discrimination, contact detection, pressure pain threshold, and pressure pain tolerance. Using the clinical neurosensory testing scale, sensory impairment scores were assigned preoperatively and at each follow-up appointment. Improvement was defined as a score of normal, mild, or moderate.

Recovery of neurosensation

Post operative neurosensory testing

- 3, 6 and 12 months using the clinical neurosensory assesment–brush stroke directional sensation, static 2-point discrimination, contact detection, pressure pain threshold, and pressure pain tolerance

Recovery and gap length

- 8 to 20 mm - 86%
- 30 to 70 mm – 89%

Time to repair

- >90 days – 100% improvement

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