Dental Implants

From the beginning up to now

By:

Dr Arash Khojasteh

WHAT IS A DENTAL IMPLANT?

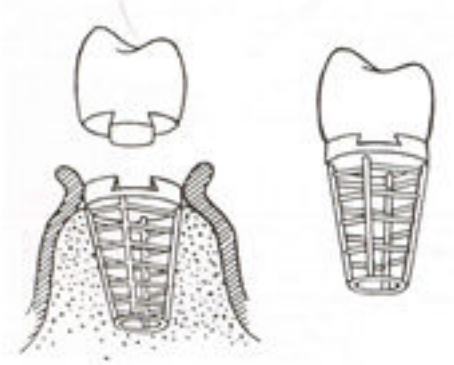
Dental implant is an artificial fixture which is placed surgically into the jaw bone to substitute for a missing tooth and its root(s).

Ancient Implants

- 16 th Dark stone (Egypt - South America)
- 17 th Carved ivory teeth

Early Implants

- 1809 Gold implant
- e.20th Lead, iridium, tantalum, stainless steel and cobalt alloy
- 1913 Greenfield's hollow basket (iridium + gold wires)

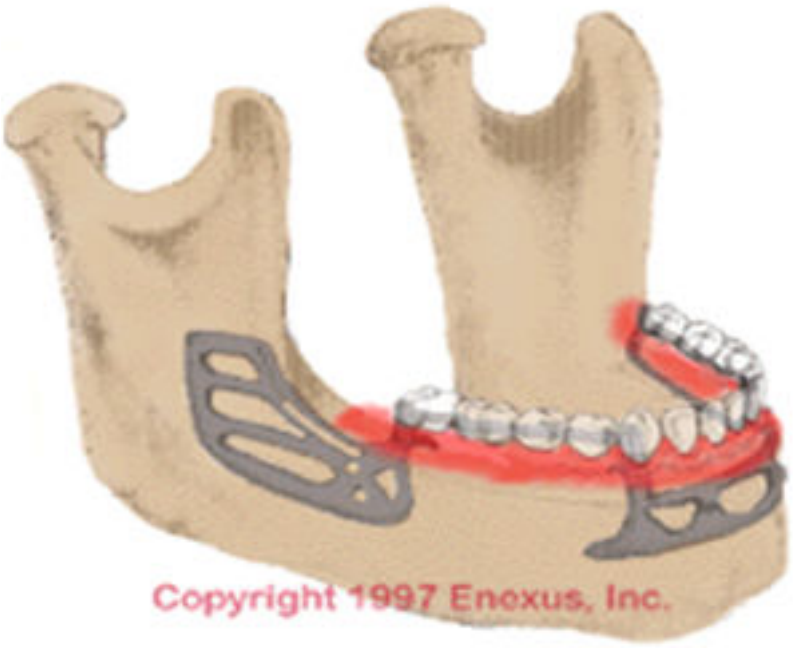


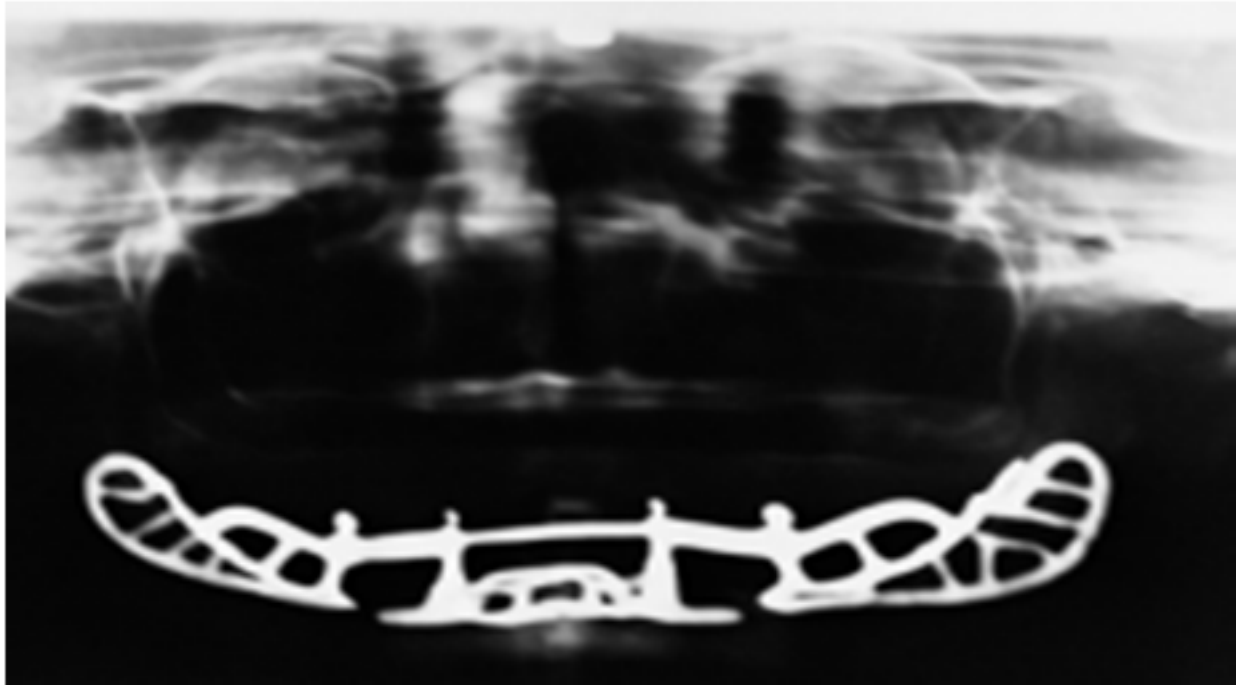
- 1937 Adams's submergible threaded cylindrical implant with round bottom

- 1938 Strock's threaded vitallium implant
  (cobalt + chrome + molybdenum)

Subperiosteal Implants

- Placing implants on and around bone rather than in it
- 1943 Dahl of Sweden placed with 4 projecting posts
- Direct bone impression
- Cobalt-chrome-molybdenum casting


Copyright 1997 Enexus, Inc.

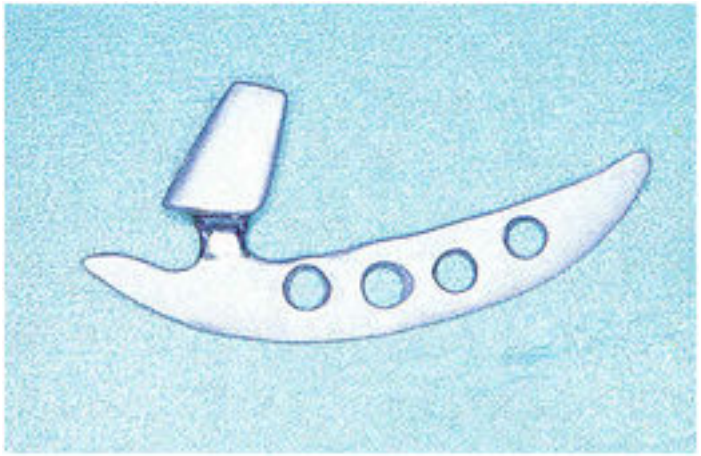


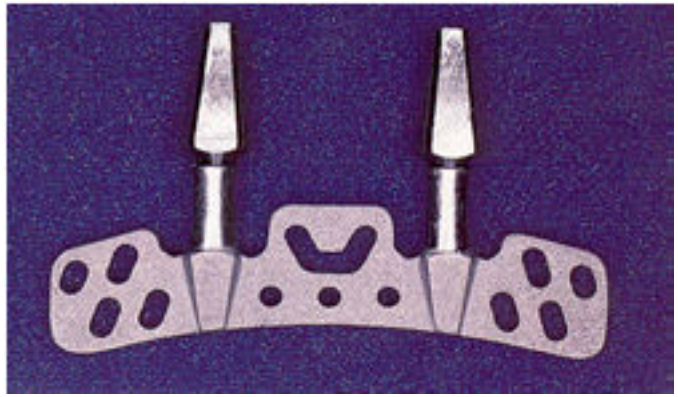
One-stage pins and screws

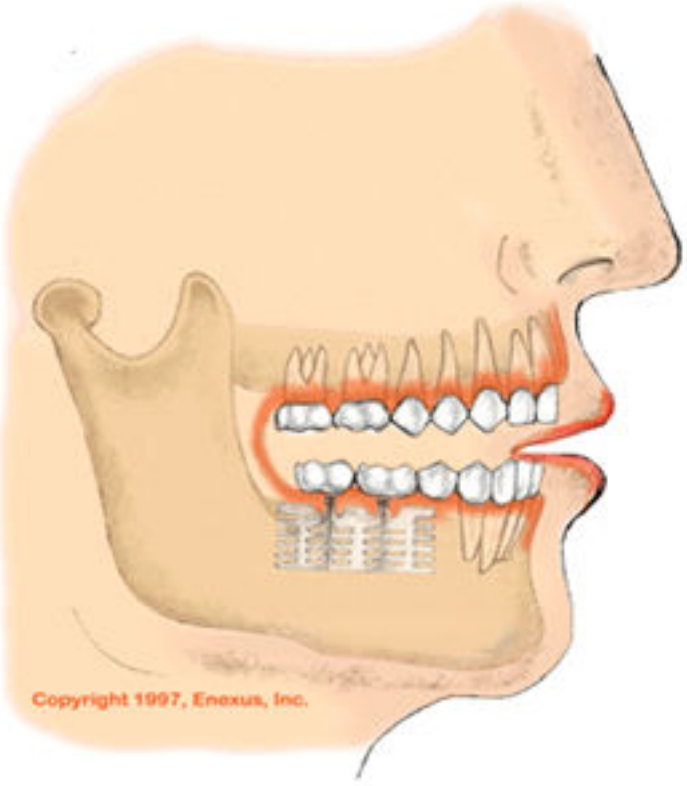
- Early 1960s pin, screw, and cylinder shaped implants
- One piece and not submerged
- Did not osseo-integration
- Fibrous peri-implant membrane
- Shock-absorbing claim

Blade Implants

- 1967 Linkow blade implant - in narrow ridges
- Required shared support with natural teeth
- 1970 Roberts and Roberts – Ramus blade implant (titanium)

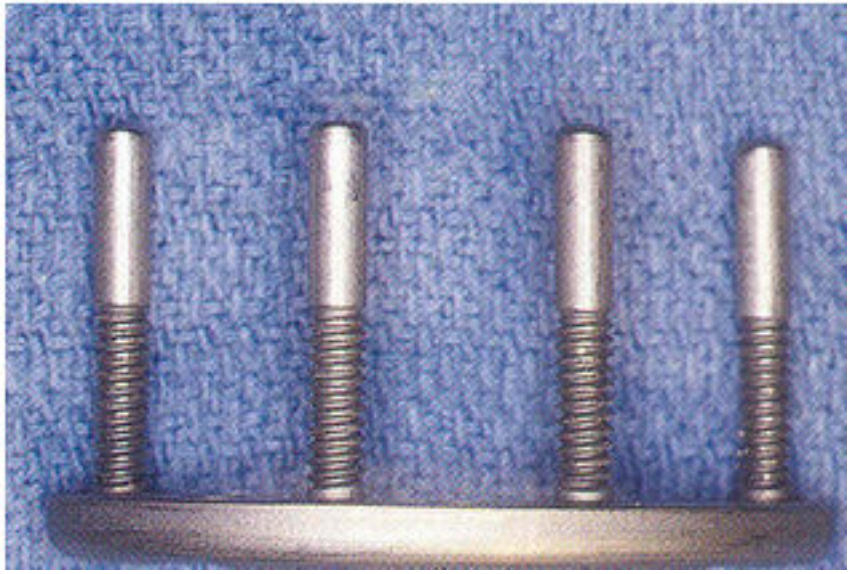


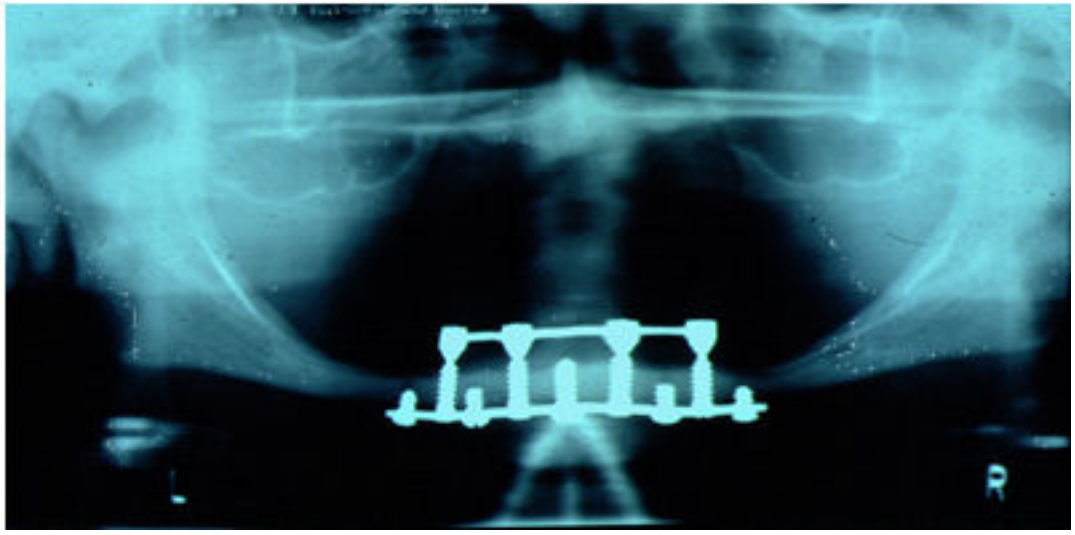




Transosteal Implants

- 1975 Small introduced transosteal mandibular staple bone plate
- Limited to mandible only




L
R

Osseointegrated Implants

In 1952, Professor Per-Ingvar Branemark, a Swedish surgeon, while conducting research into the healing patterns of bone tissue, accidentally discovered that when pure titanium comes into direct contact with the living bone tissue, the two literally grow together to form a permanent biological adhesion. He named this phenomenon *"osseointegration".*

- The Toronto Conference opened the door to prompt widespread recognition of the Branemark implant.
- The discovery of osseointegration has been one of the most significant scientific break throughs in dentistry.

First Implant Design by Branemark

All current implant designs are modifications of this initial design

Fibro-osseous integration

- Fibroosseous integration
  – *"tissue to implant contact with dense collagenous tissue between the implant and bone"*
- Seen in earlier implant systems.
- Initially good success rates but extremely poor long term success.
- Considered a "failure" by todays standards

Osseointegration

- Success Rates >90%
- Histologic definition
  - "*direct connection between living bone and load-bearing endosseous implants at the light microscopic level.*"
- 4 factors that influence:

  Biocompatible material

  Implant adapted to prepared site

  Atraumatic surgery

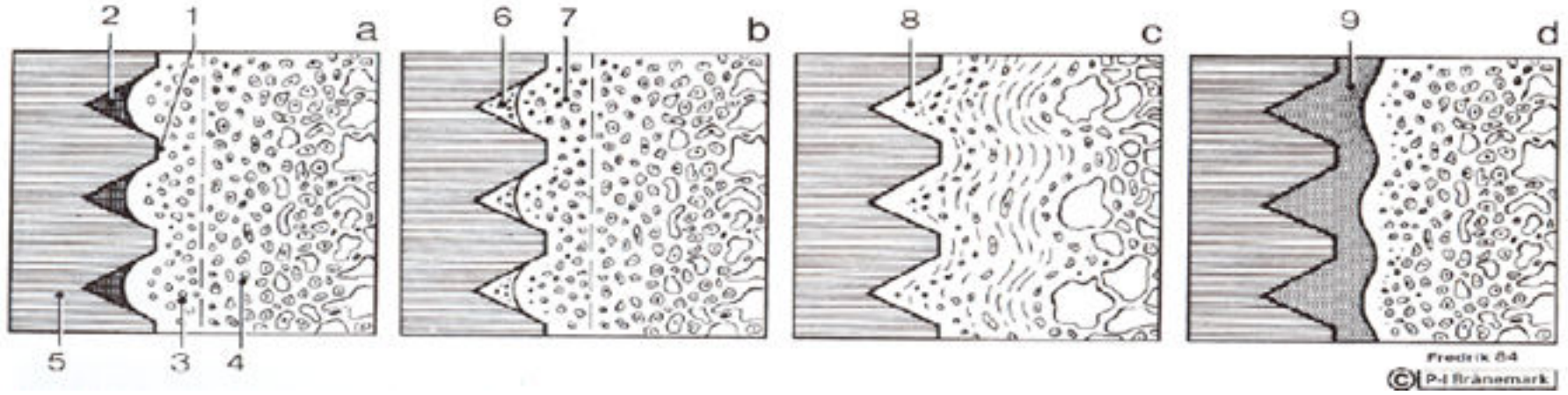
  Undisturbed healing phase

(A) Hematoma occurs near screw threads

(B) After 3 weeks – Osteoblasts begin forming spongy bone

(C) After 4 months – spongy bone replaced by compact bone Lamellar bone – strongest type of bone, most desired next to implant

(D) Osseointegration failure



Implant Material

Desired Mechanical Properties :

- High yield strength
- Modulus close to that of bone's
- Built-in margin of safety: Changes in environment around implant

Titanium grades

- Titanium grades 1-4 are commercially pure, meaning made of just titanium unlike grade 5.
- As the grade goes up, the stronger the titanium.
- Grade 5 contains aluminum and vanadium along with titanium, making it stronger than grades 1-4.

Metallic Implant Surface

Problem:

Implant surface change with time due to oxidation, precipitation , …

Possible solutions:

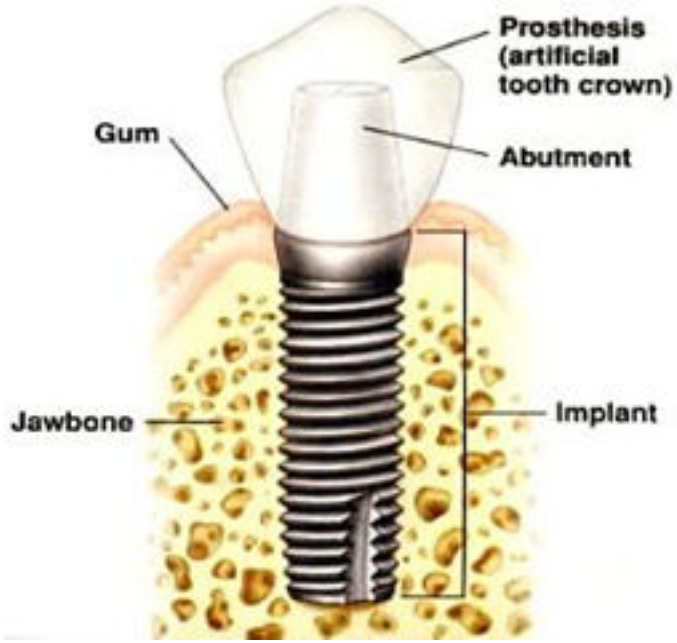
- Oxide layers (minimize ion release)
- Prosthetic component from noble alloys
- Phase stabilizers other than Al & V (e.g. Ti-13Nb-13Zr, Ti-15Mo-2.8Nb)
- Surface Modifications

Surface modification

- Passivation
- Ion implantation
- Texturing

The Parts of an Implant

- Implant body-fixture
- Abutment (gingival/temporary healing vs. final)
- Prosthetics



Implant Indications

- Fully edentulous
- Partially edentulous
- Single tooth

Implant Treatment Plan

Team Approach :

A surgical – prosthodontic consultation is done prior to implant placement to address:

- soft-tissue management
- surgical sequence
- healing time
- need for ridge and soft-tissue augmentation

Specific Medical Conditions

- Diabetes
- Coronary artery disease
- Alcoholism
- Drug therapy
  - anticoagulants
  - anti epileptics
  - antidepressants
  - others
- Osteoporosis
- Smoking

Presurgical Mouth Preparation

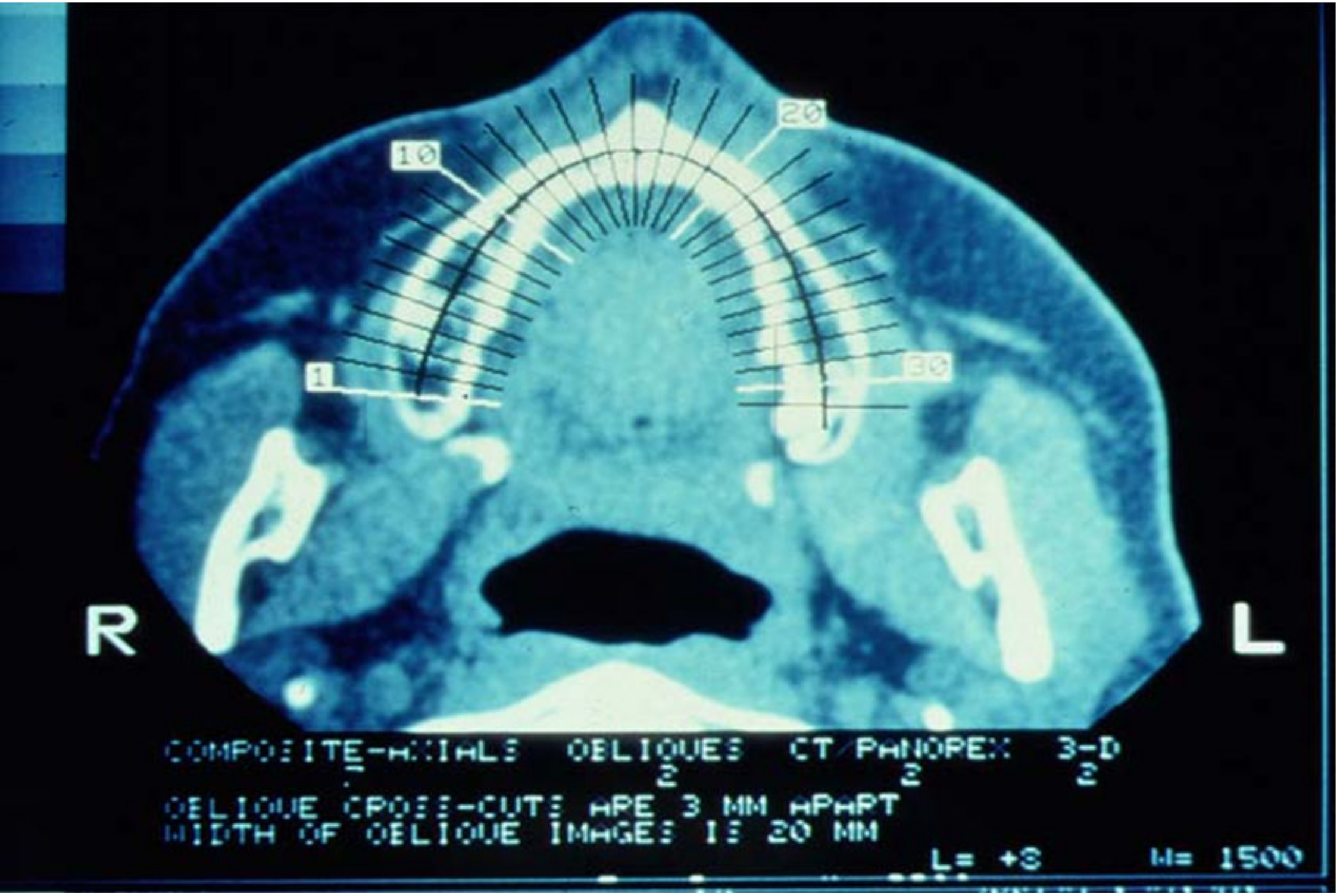
- Extractions
- Necessary restorative dental procedures
- Periodontal therapy
- Endodontal therapy
- Orthodontal therapy
- Prophylatic splinting
- Presurgical measurement radiograph with surgical template in place

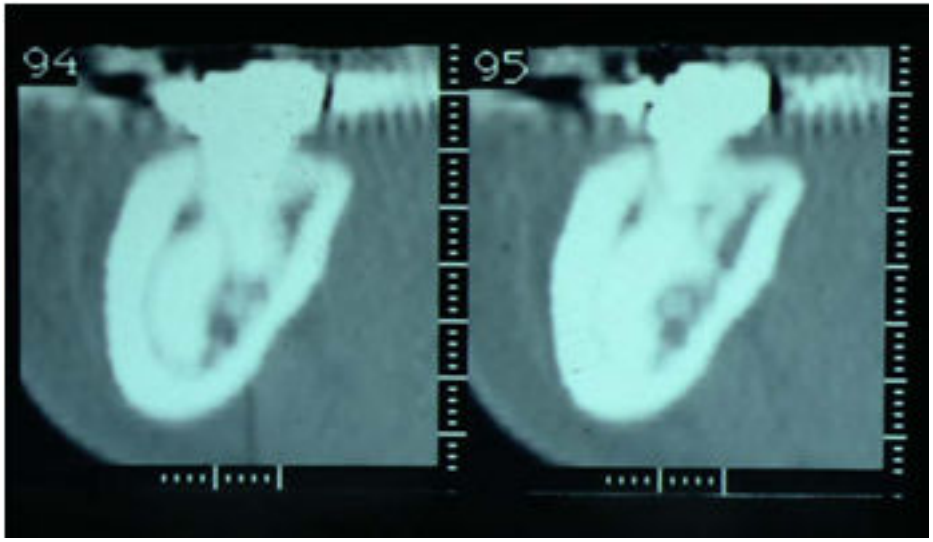
Radiological / Imaging Studies

- Periapical radiographs
- Panoramic radiograph
- Site specific tomograms
- CT scan (Denta-scan, cone beam CT)

Diagnosis

- Bone Quantity
- Bone Quality
- Associated structures
  - inferior alveolar nerve
  - mental nerve
  - maxillary antrum
  - nasal floor
  - incisive canal
- Pathology
  - retained dental remnants
  - periapical pathology
  - cysts
  - other pathology


10
20
1
30
R
L
COMPOSITE-AXIAL: OBLIQUE: CT/PANOREX: 3-D
2 2 2
OBLIQUE CROSS-CUT: APEX 3 MM APART
WIDTH OF OBLIQUE IMAGE: 20 MM
L= +3
W= 1500


94
95

Alveolar Form

A Good alveolar ridge form

B Moderate residual ridge form

C Advanced resorbtion / Basal bone only

D Basal bone resorbtion

E Extreme resorbtion

Bone Quality

1 Mainly cortical plate compact bone

2 Thick compact bone with a dense trabecular core

3 Thin cortical plate with dense trabecular core

4 Thin cortical plate with low density trabecular core

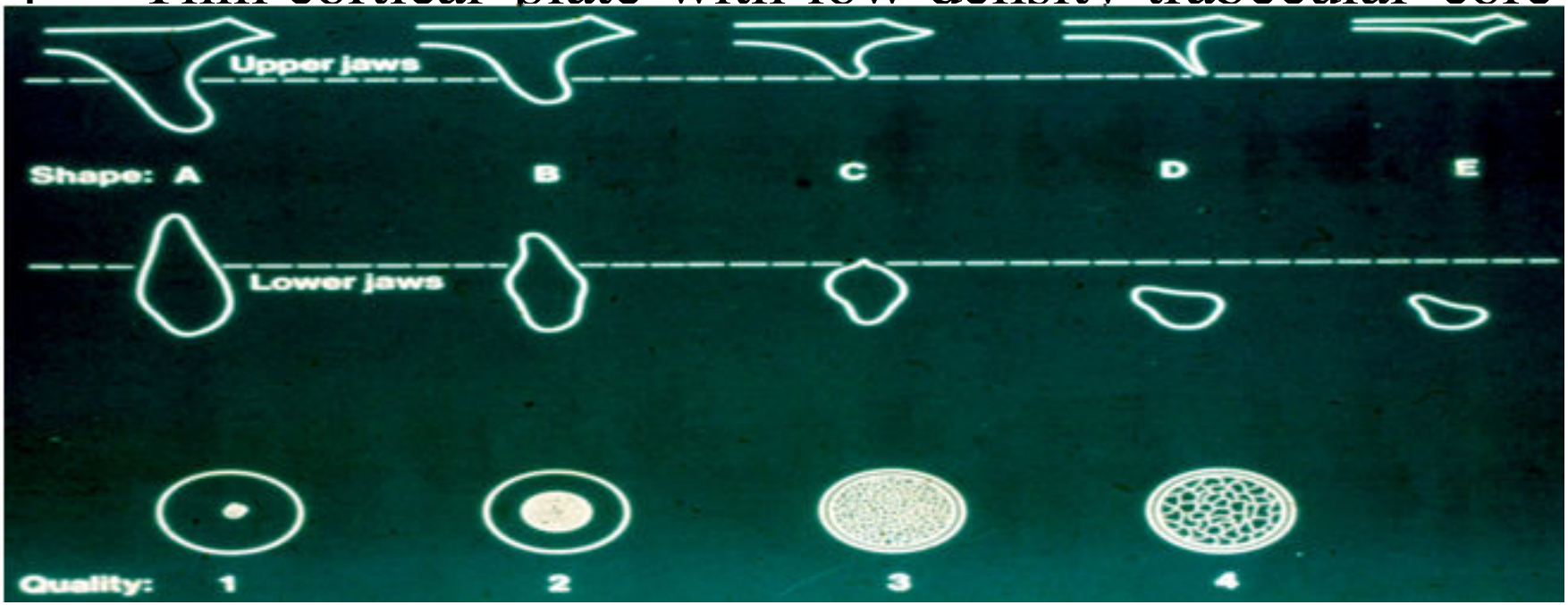


Image Distortion

Table 1. DISTORTION OF RADIOGRAPHIC IMAGING TECHNIQUES

Radiographs	Actual Distortion	% Distortion
Periapical	0.5–5.5 mm; mean = 1.9 mm	8%–24%; mean = 14%
Panoramic	0.5–7.5 mm; mean = 3 mm	5%–39%; mean = 23.5%
CT scans	0.0–0.5 mm; mean = 0.2 mm	0–8%; mean = 1.8%

Data from Sonic M, Abrahams J, Faiella RP: A comparison of the accuracy of periapical, panoramic, and computerized tomographic radiographs in locating the mandibular canal. International Journal of Oral and Maxillofacial Implants 9:455, 1994.

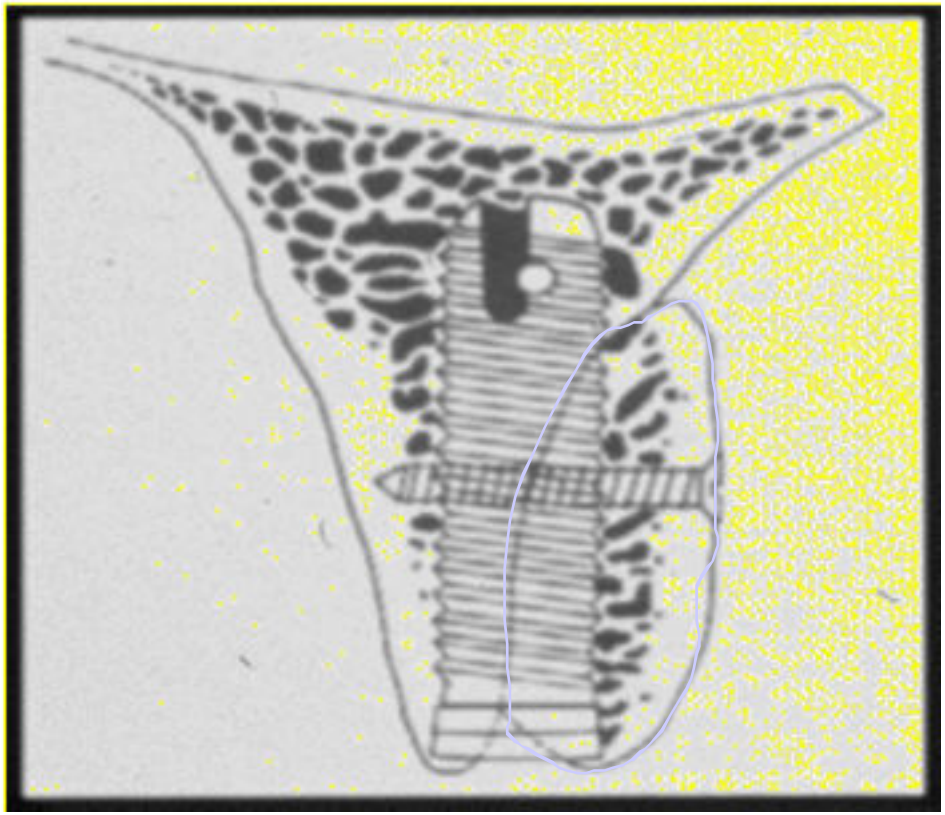
Anatomic Limitations

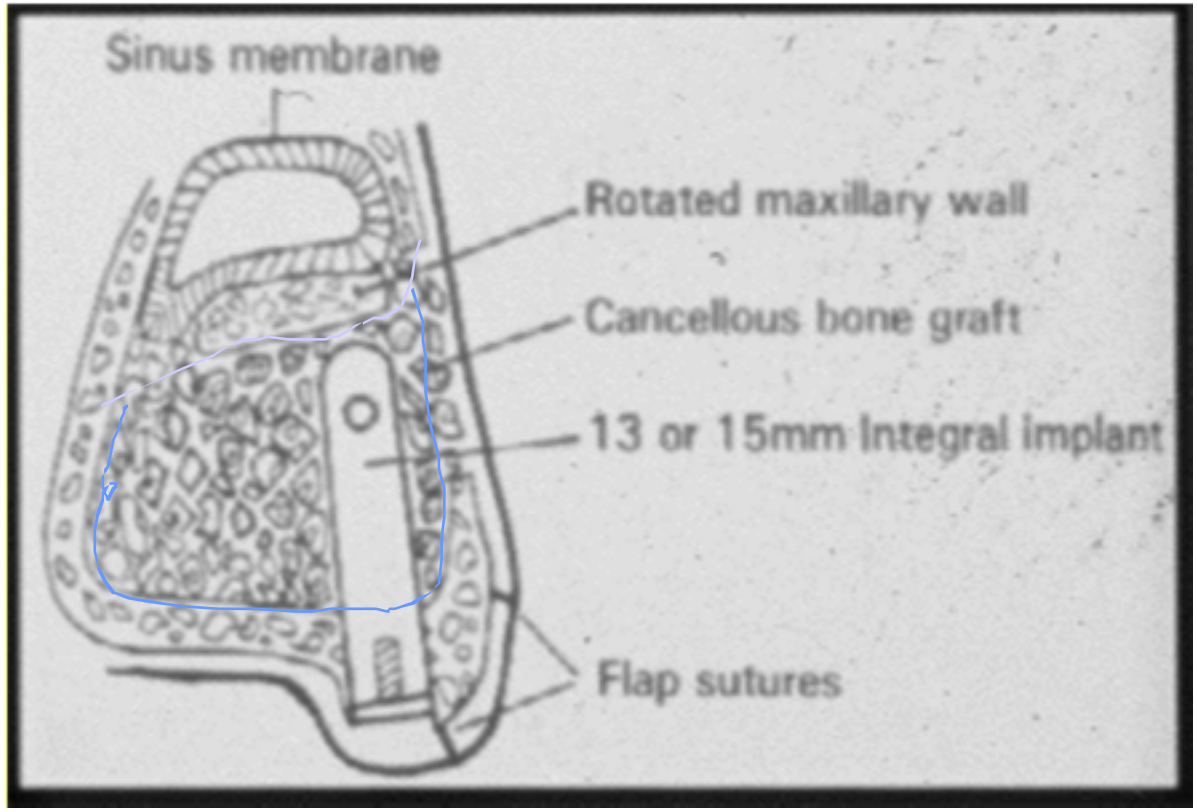
Buccal Plate	0.5mm
Lingual Plate	1.0 mm
Maxillary Sinus	1.0 mm
Nasal Cavity	1.0mm
Incisive canal	Avoid
Interimplant distance	1-1.5mm
Inferior alveolar canal	2.0mm
Mental nerve	5mm from foramen
Inferior border	1 mm
Adjacent to natural tooth	0.5mm

Maxillary Implants

- Lack of well defined cortex
- Poorer quality cancellous bone
- Lack of bucco/lingual width
- Reduced height of available bone
- Proximity of anatomical structures
  - nose
  - antrum
  - incisive canal

Surgical Solutions to Anatomical Limitations





Surgery

Surgical Procedure

STEP 1: INITIAL SURGERY
STEP 2: OSSEOINTEGRATION PERIOD
STEP 3: ABUTMENT CONNECTION
STEP 4: FINAL PROSTHETIC RESTORATION

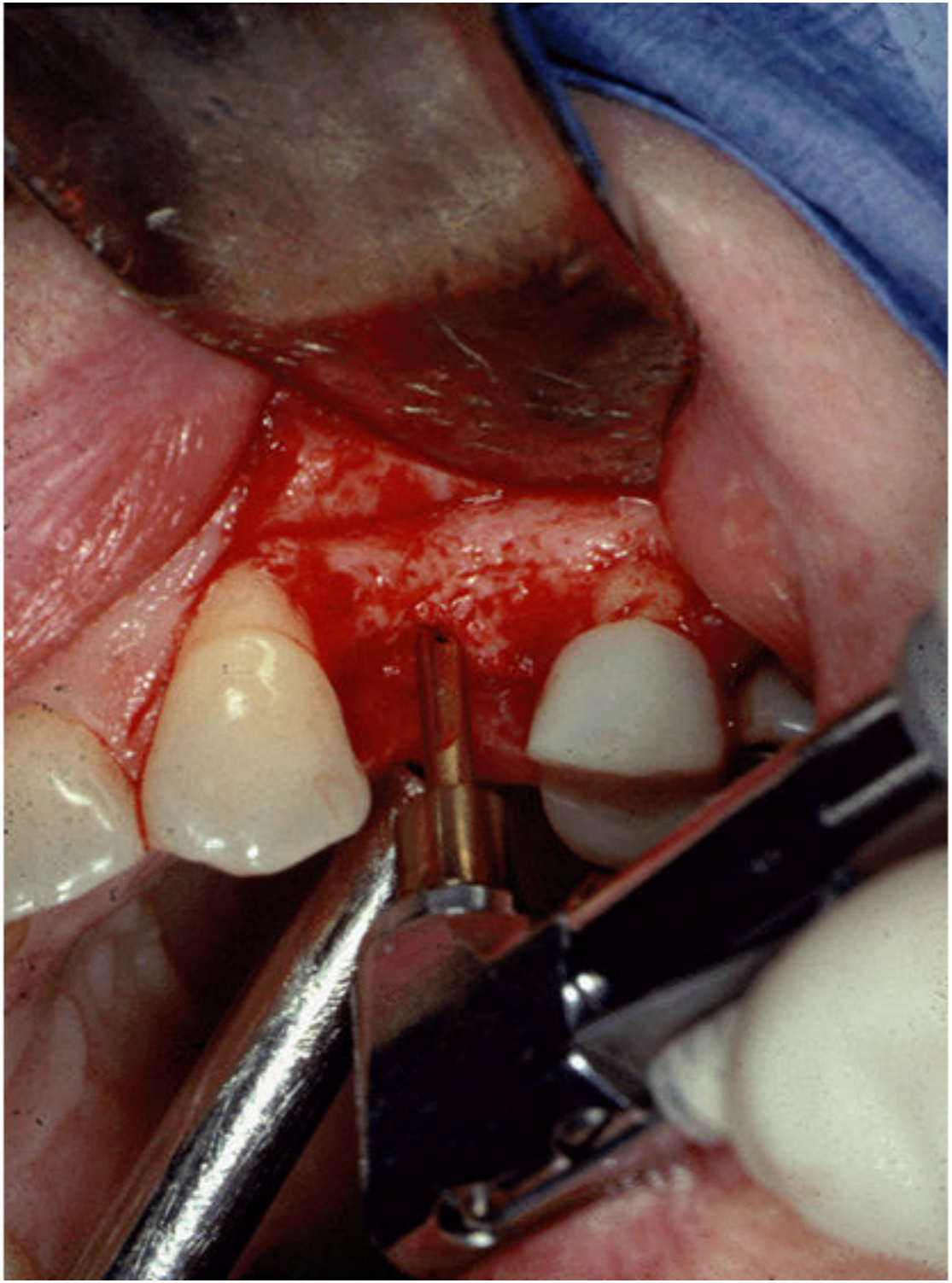
Surgical Requirements

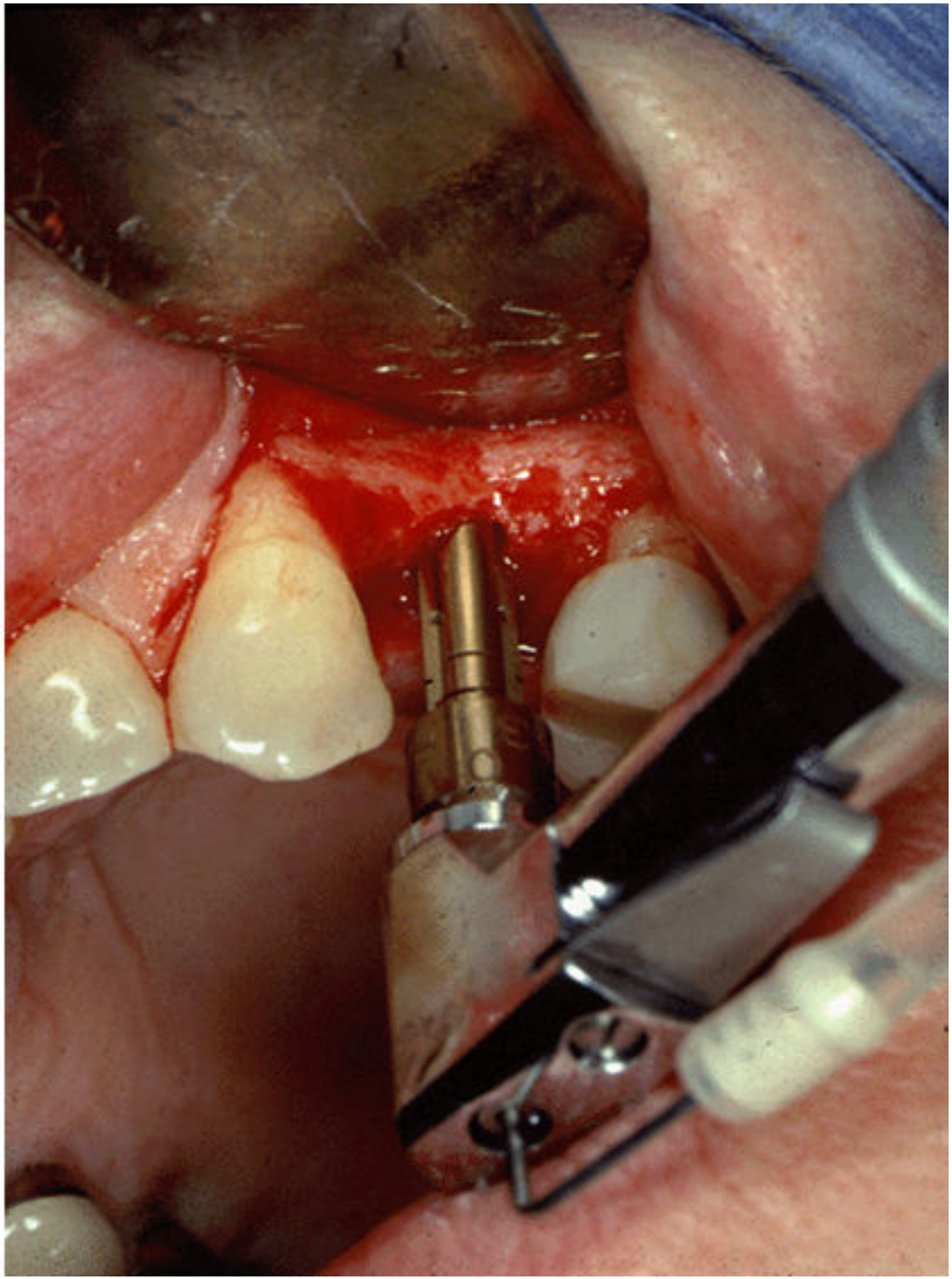
- Standardised surgical protocol
- Surgical environment
- Implant equipment
  - reusable
  - disposable/single use
- Fully evaluated and prepared patient
- Trained staff

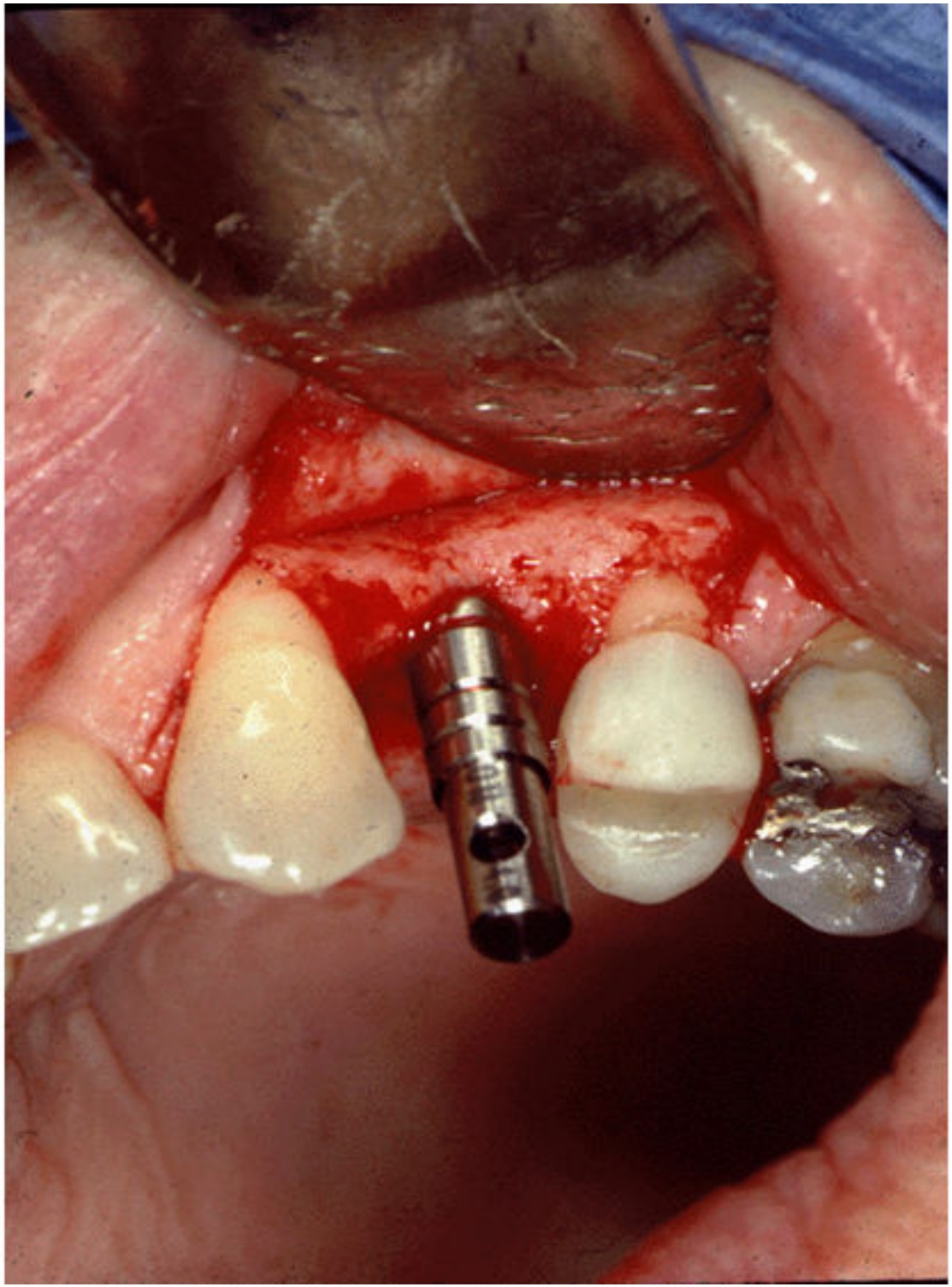
Surgical Preliminaries

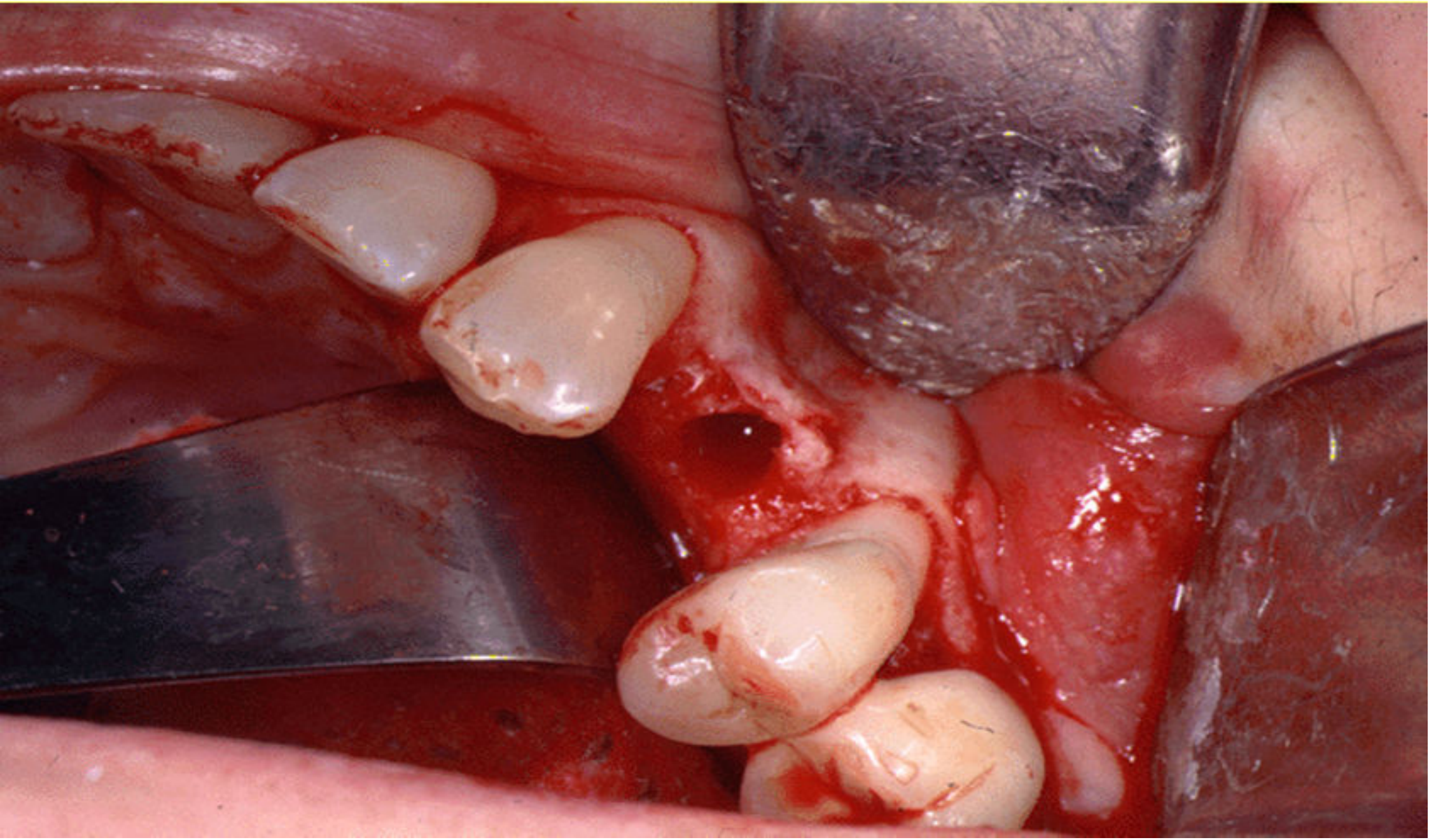
- Induction of anesthesia
- Endotracheal intubation
- Throat pack
- Scrub and gown
- Surgical preparation
- Draping

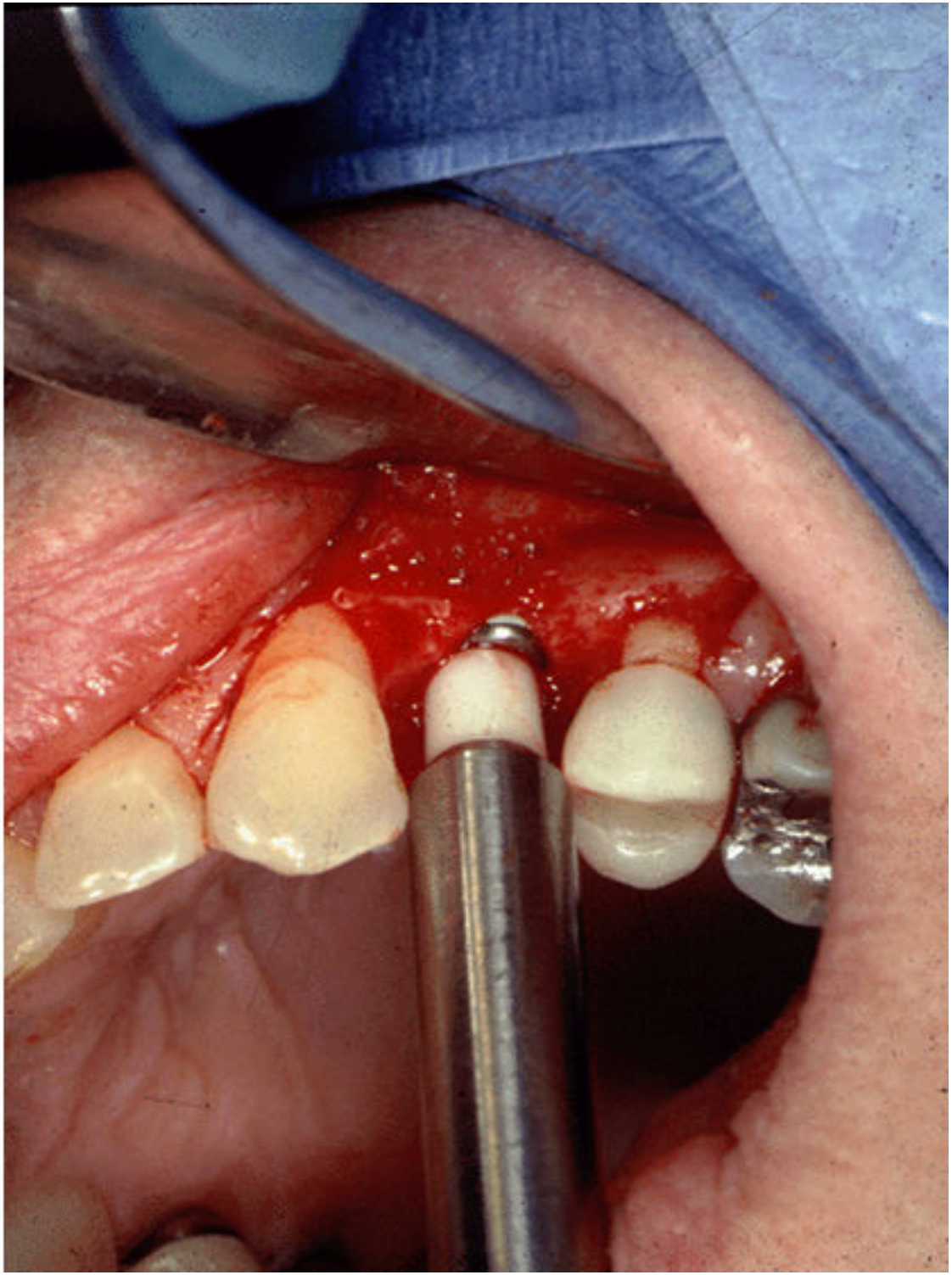
First Stage

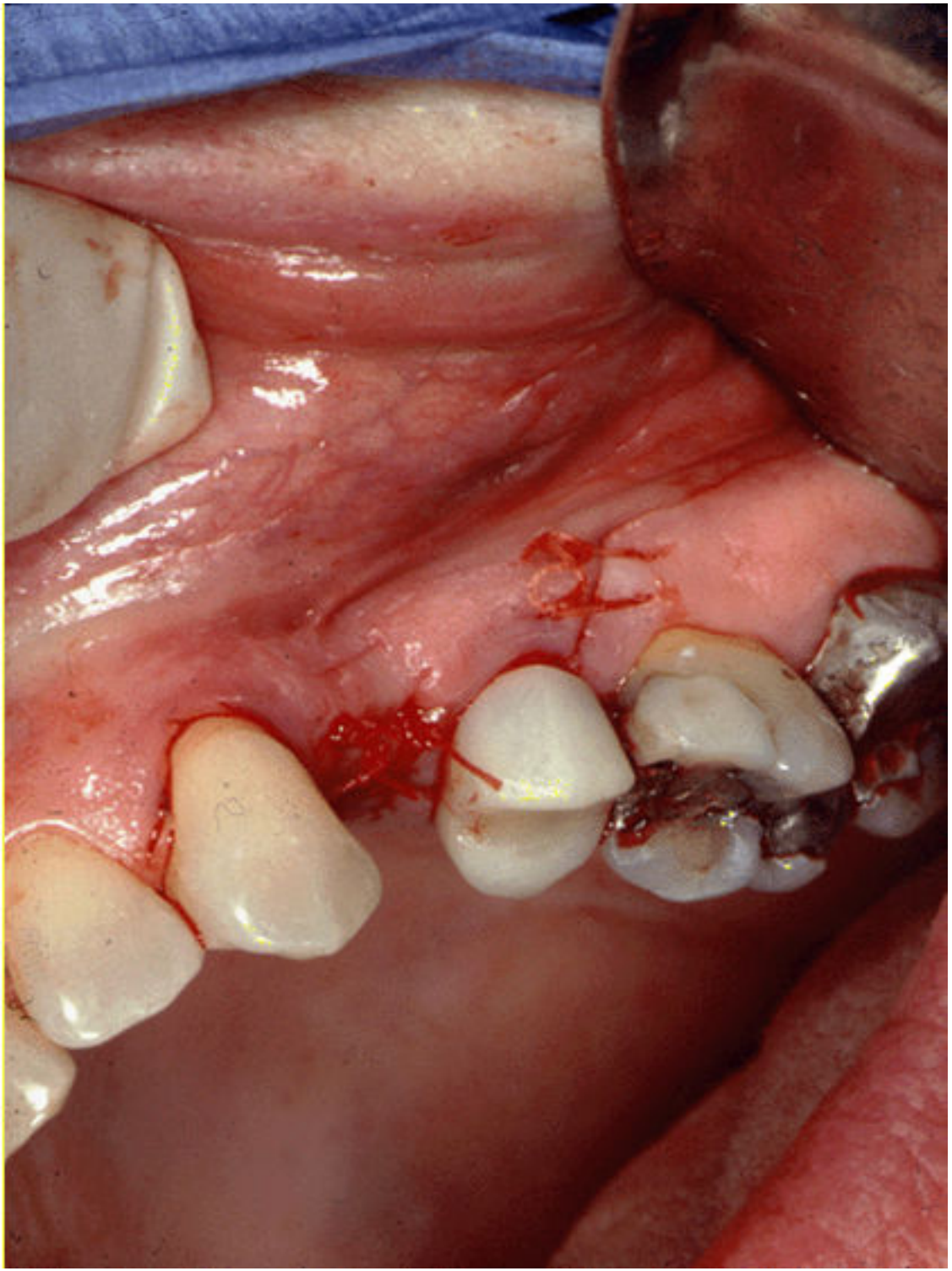












Post-Operative Care

- Hemostasis
- Analgesia
- Antibiotic regime
- Chlorhexidine mouthwash
- Suture removal
- Temporary prosthesis

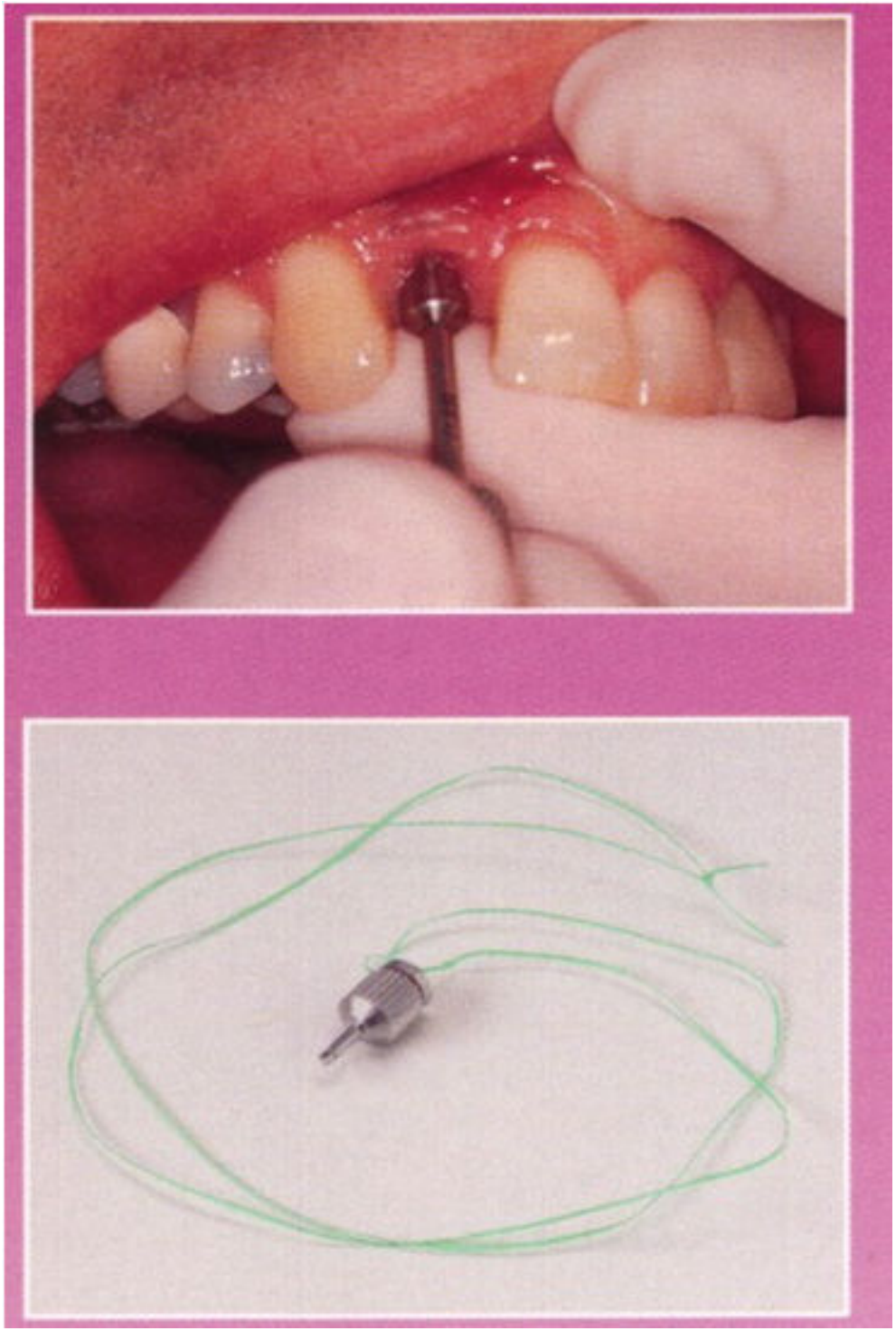
Second Stage

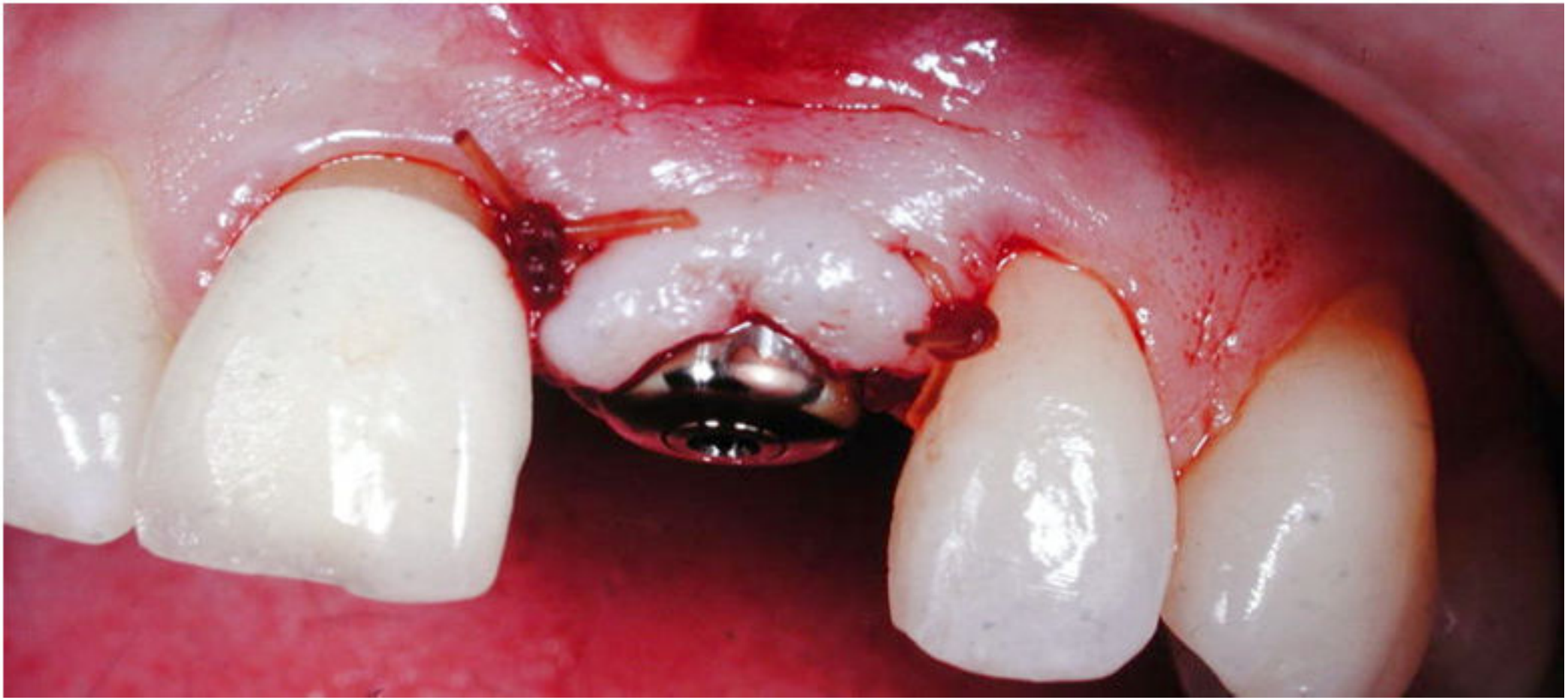
Second Stage

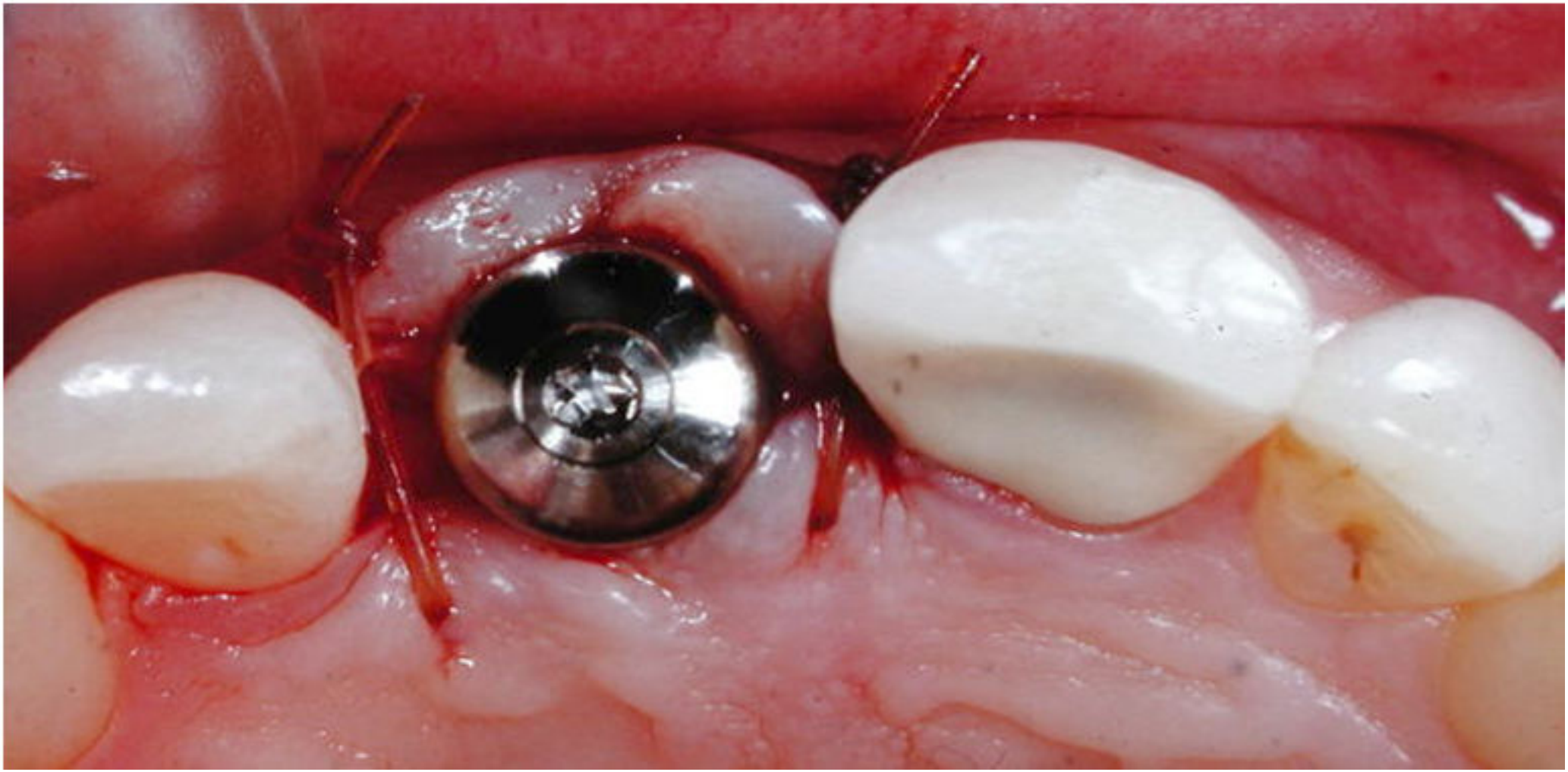
3-6 months after stage I

- Done under local anesthesia
- Pre-op medications
  - Chlorhexidine rinse

- Soft tissue
- Bone removal
- Cover screw removal
- Healing abutment
- Replacement
- Dressings







Complications

Complications

- Preoperative
- Perioperative
- Postoperative
- Transient
- Persistent
- Permanent
- Soft tissue
- Hard tissue

Serious complications

- Jaw fracture
- Hemorrhage
- Ingestion
- Inhalation
- Neurological
- Death

Preoperative

- Failure to obtain anesthesia
- Hemorrhage
- Stuck implant
- Loose implant
- Lost implant

Perioperative

- Lack of precision
- Thermal injury
- Faulty placement
- Damage to adjacent structures
- Hemorrhage
- Stuck implant
- Loose implant
- Lost implant
- Fractured drill
- Sheared implant hex
- Excessive countersink
- Eccentric drill

Postoperative

- Wound dehiscence
- Infection
- Mucosal perforation
- Fistula formation
- Hematoma
- Jaw fracture
- Sinusitis

Faulty placement

- Labial / buccal
- Lingual
- Too close
- Straight line in mandibular anteriors
- Angulation
- Divergence
- Correct by use of a surgical template

Maintenance

Criteria For Success:

- no peri-implantitis
- no associated radiographic radiolucency
- marginal bone loss 1.0-1.5mm first year; then < 0.1mm annually thereafter
- tissue integration: bone/soft tissue “osseointegration”
- absence of mobility
- no progressive soft tissue changes or bone loss
- stable clinical attachment level
- absence of bleeding upon probing/excessive probing depths
- absence of discomfort
- success rate varies with bone quality, loading dynamics, etc.

Success Rates

	%
Subperiosteal	39 - 90
Staple	95
Vitreous carbon	50
Blade	65 - 90
Osseointegrated	80 - 100

Clinical Parameters of Evaluation

- oral hygiene including plaque index
- implant stability (evaluate mobility)
- retrievability
- peri-implant tissue health
- crevicular probing depths
- bleeding
- radiographic assessment (serial)
  - crestal bone level & integrity of attachment systems
- proper torque on screw joints
- occlusion

Management of failure

- Failing implants FAIL
- Removal
- Abandon
- Alternative site
- Larger diameter
- Replacement after healing

Exposure of implants using a modified multiple-flap transposition vestibuloplasty

Aim

To introduce a minimally invasive operation to improve the condition of the soft tissues around the implants in an atrophied mandible, at the same time, as uncovering the implants

Patients and method

- 11 patients
- four implants in the interforaminal region
- follow-up period of 55 months

Results

- Adequate exposure
- ttached gingiva 4–9mm wide were attained
- no bleeding on probing

Patients and methods

- Eleven patients each had four implants inserted in the interforaminal region of their atrophied mandibles
- L/A
- Four of them had had osteoplasties
- One patient had had ablative and reconstructive operations for oral carcinoma
- follow-up period of 8 weeks to 1 year
- Clinical variables:

Inflammation

width of attached gingiva attained

success of exposure of implants

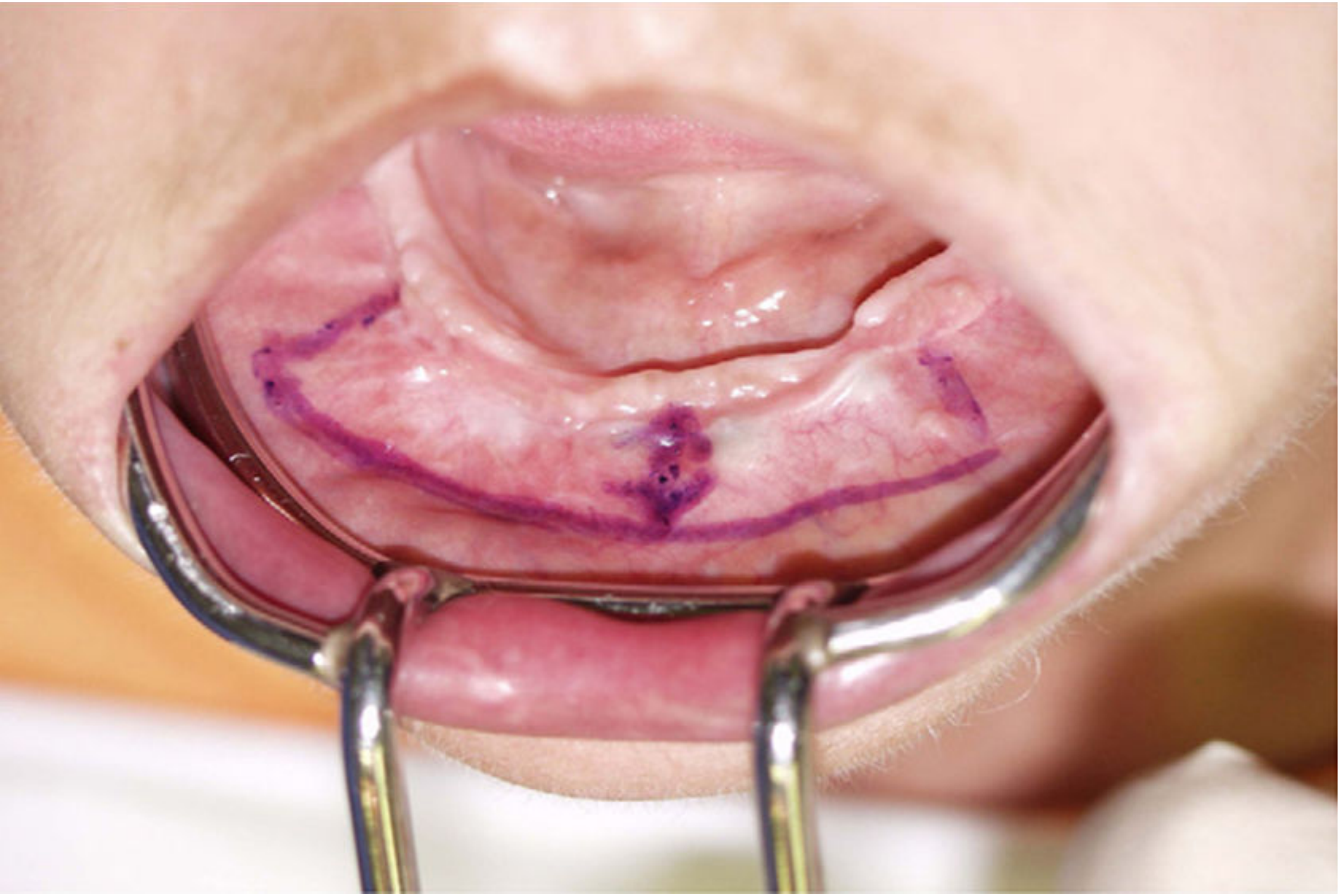
Case no.	Age (yrs)	Sex (M/F)	Width of attached gingiva (mm)		Shrinkage (%)	Duration of follow-up (weeks)
			Pre-operation	Follow-up time		
1	46	F	<1	5–6	30	8
2	50	F	<1	5–7	30	9
3	49	M	0	5–7	45	11
4	52	M	−1	5–6	40	32
5	63	F	1–3	5–6	60	36
6	60	M	1–2	7–8	65	41
7	65	M	1.5	4–6	60	44
8	59	F	0	5–6	50	55
9	81	F	1–2	7–8	50	56
10	57	M	0.5–2	8–9	35	24
11	52	M	0–1.5	6–9	30	43

Surgical technique

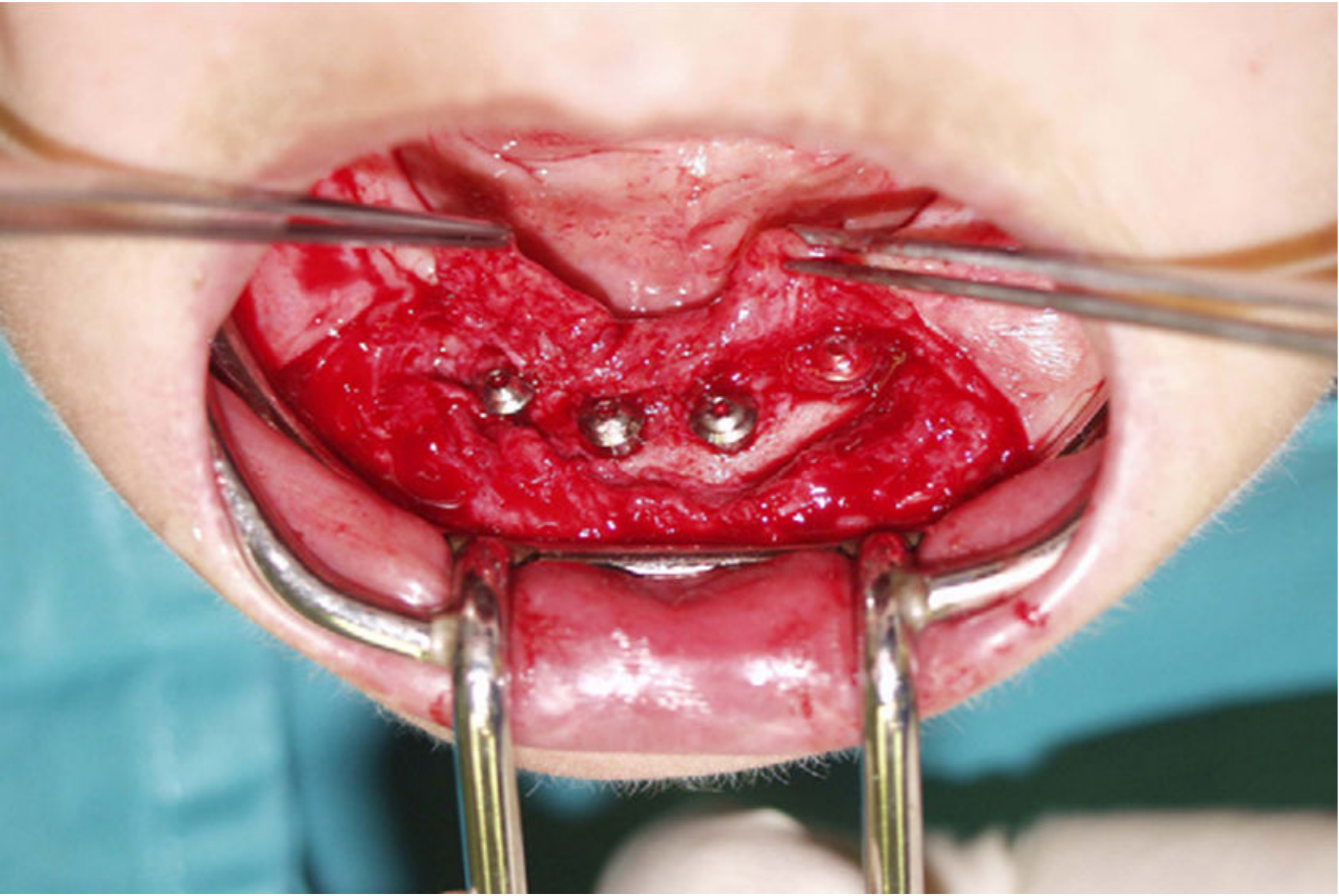
first step:

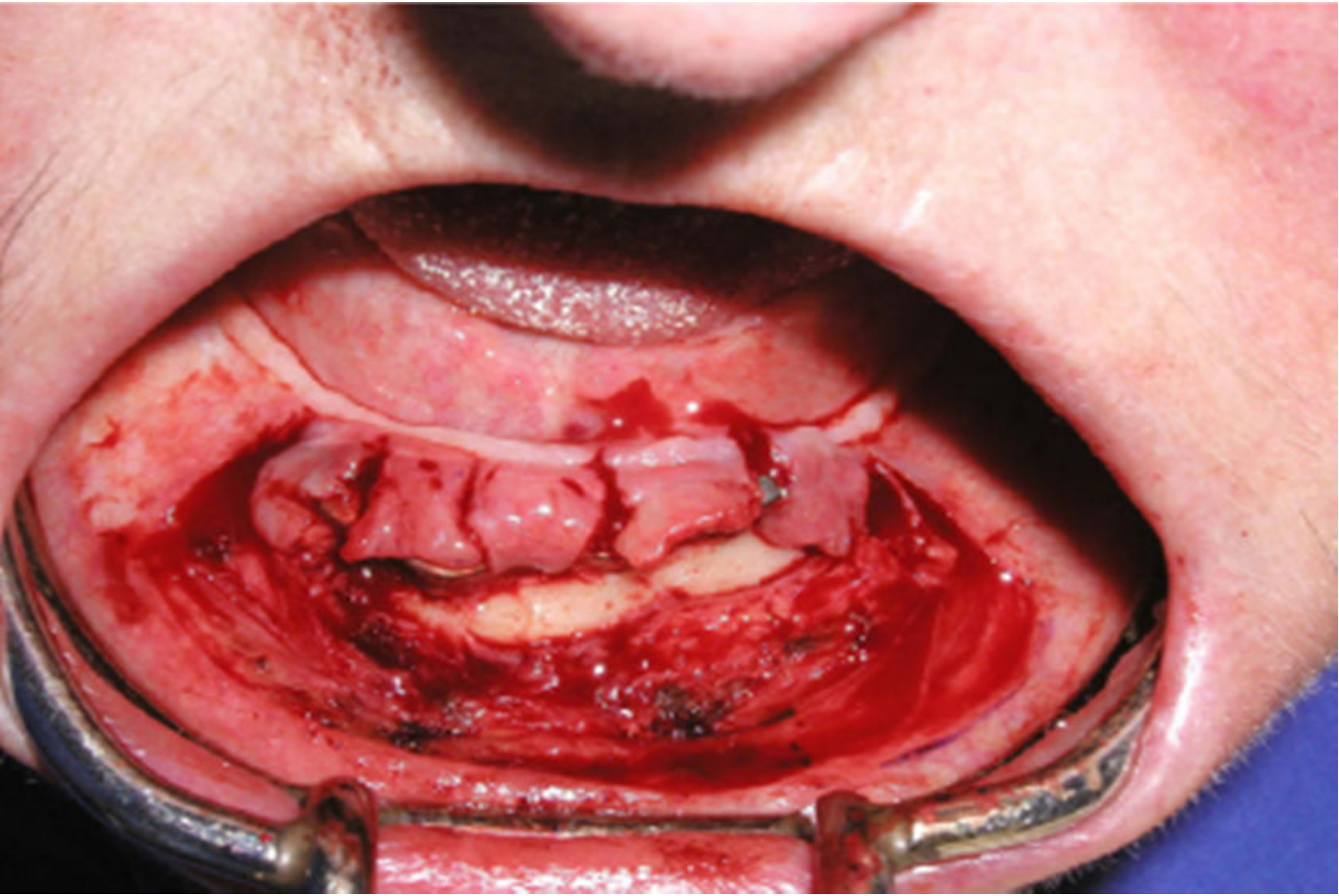
horizontal incision 1 cm labially

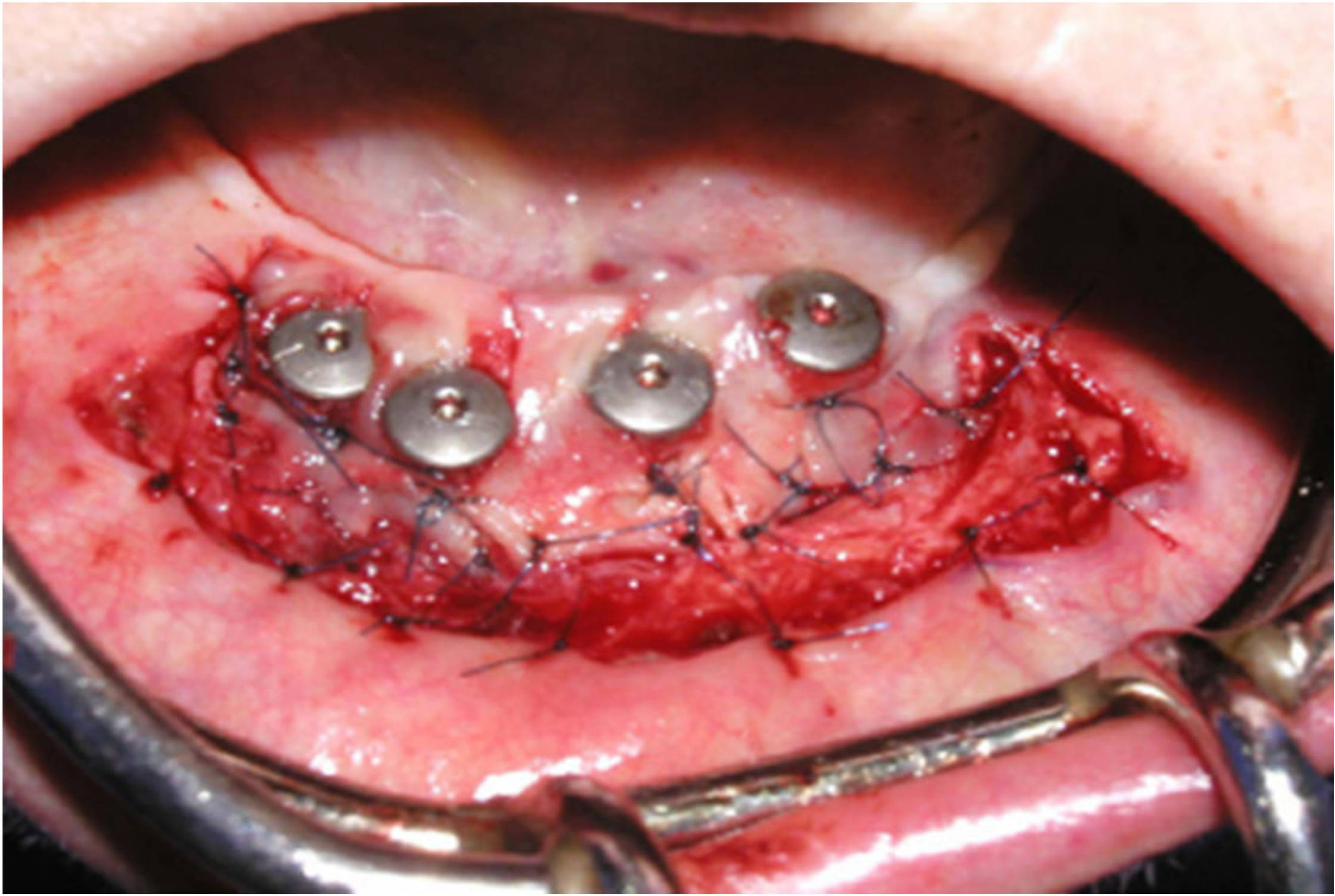
Two relief incisions

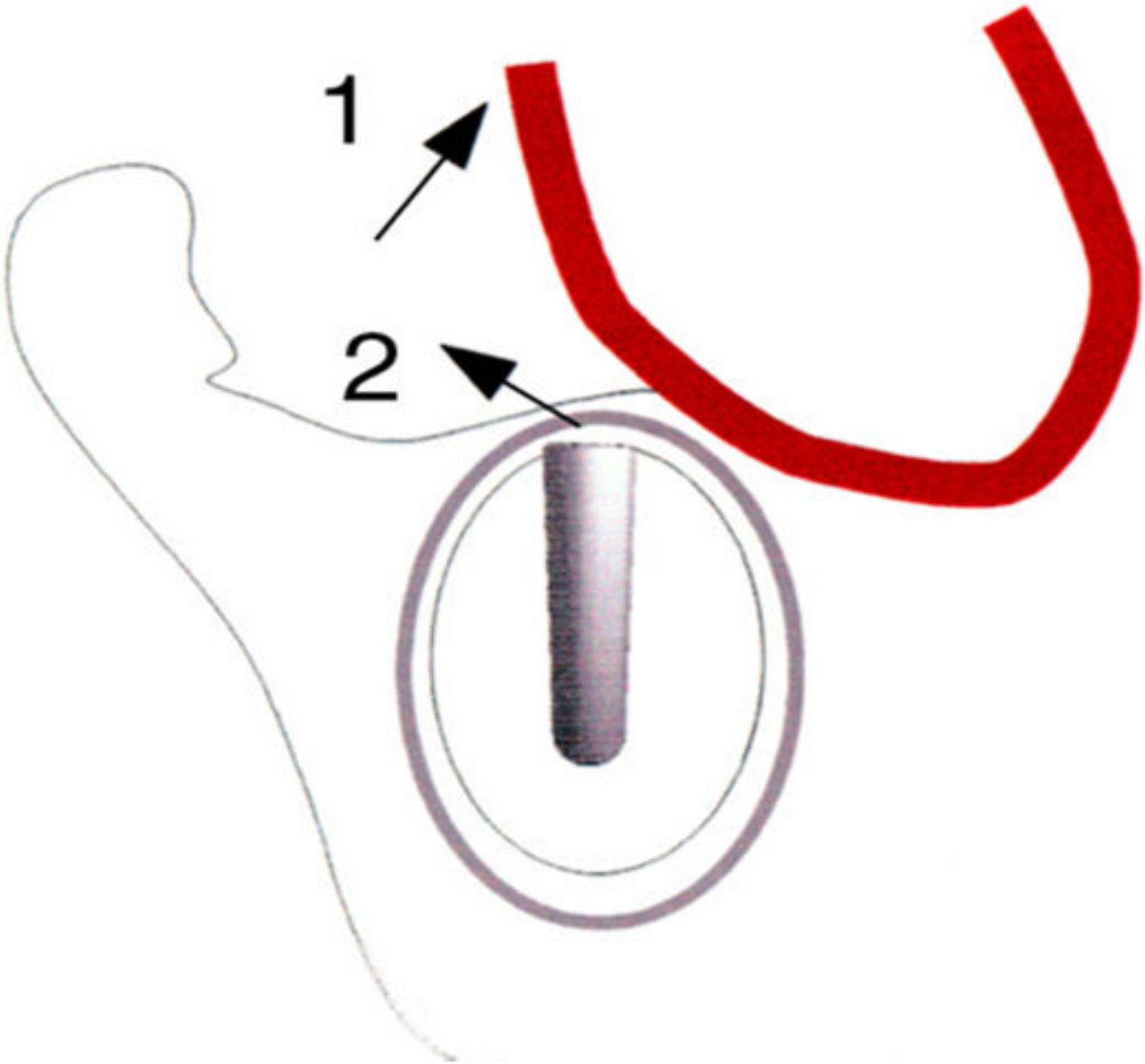


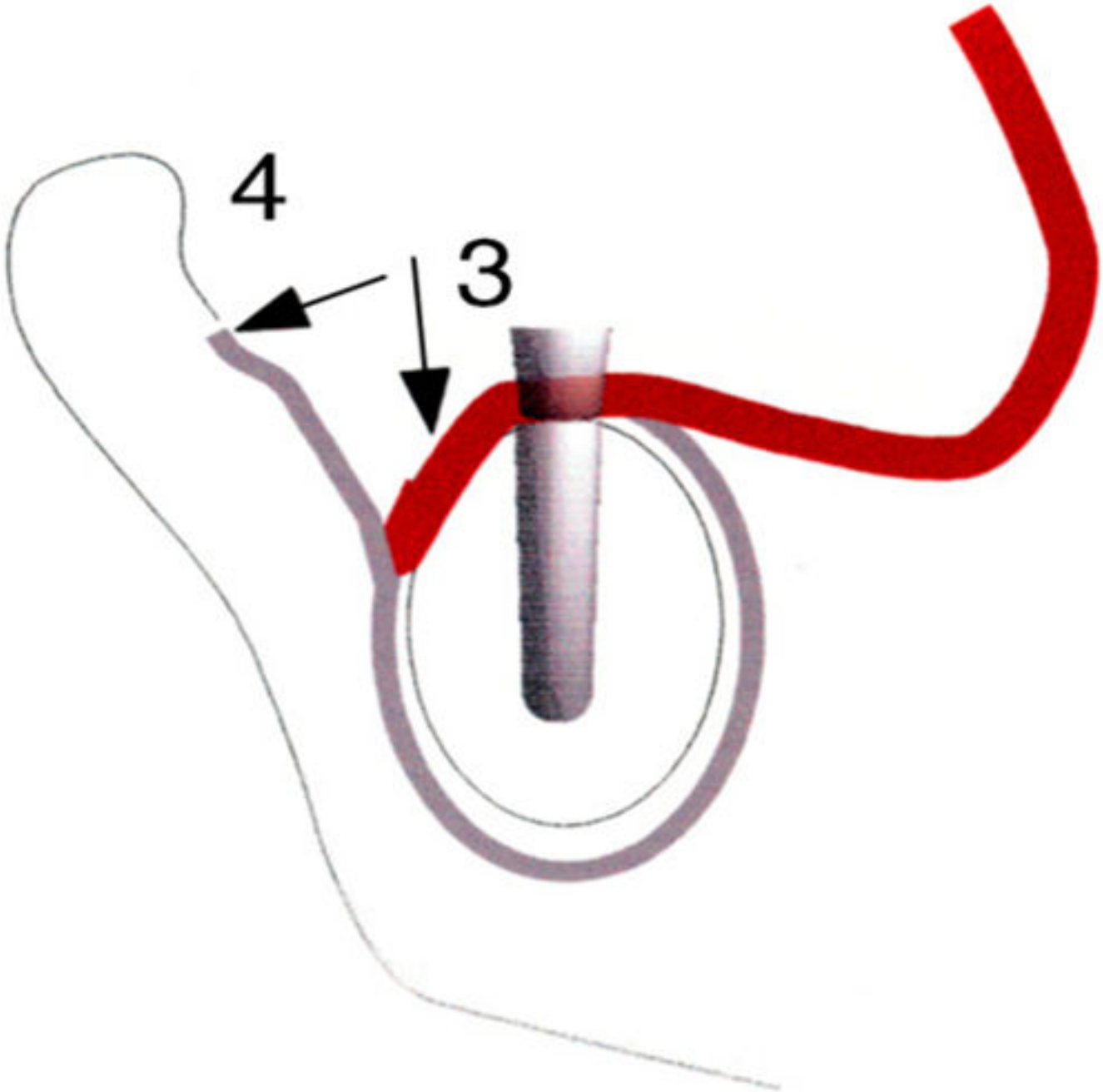
- second step:
- harvesting of a mucosal flap from the lower lip and dissecting it cranially to 2mm beyond the lingual border of the implant








1
2


4
3

Clinical evaluation

- Swelling
- Inflammation
- wound healing,
- attached gingiva
- BOP

Results

- sufficient exposure of the implants in all patients except one
- The attached gingiva measured from 5mm to 7mm 8 weeks postoperatively and 5mm to 6mm after 1 year
- Two patients had transient hypoaesthesia of the lower lip for 4–6 weeks.

- osteoplastic operation
- soft tissues

Therapeutic options

- vestibuloplasty, alone or in combination with lowering of the floor of the mouth
- Free gingival or connective tissue grafts

Kao et al

Perforation

osteoplastic operation

it is not keratinised

no need for harvesting of a free graft

- The only condition that is essential to allow this operation is that there must be at least 4–5mm between two adjacent implants to ensure a wide pedicle and sufficient blood supply for the multiple mucosal flaps