ILLUSTRATED CLINICAL GUIDE
FOR DENTISTS, ORAL AND MAXILLOFACIAL SURGEONS

Subperiosteal INSTITUTE

HUG CONCEPT

Bone over metal

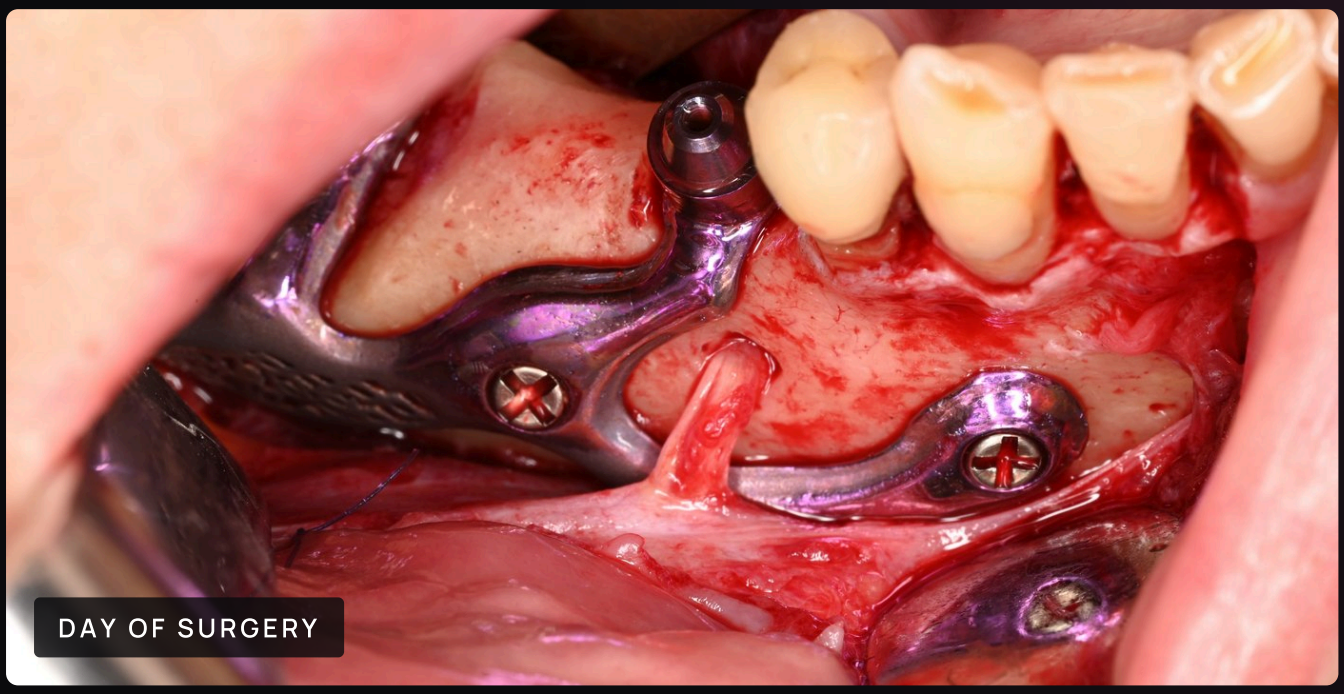
The intraosseous subperiosteal implant, from the literature to the clinic

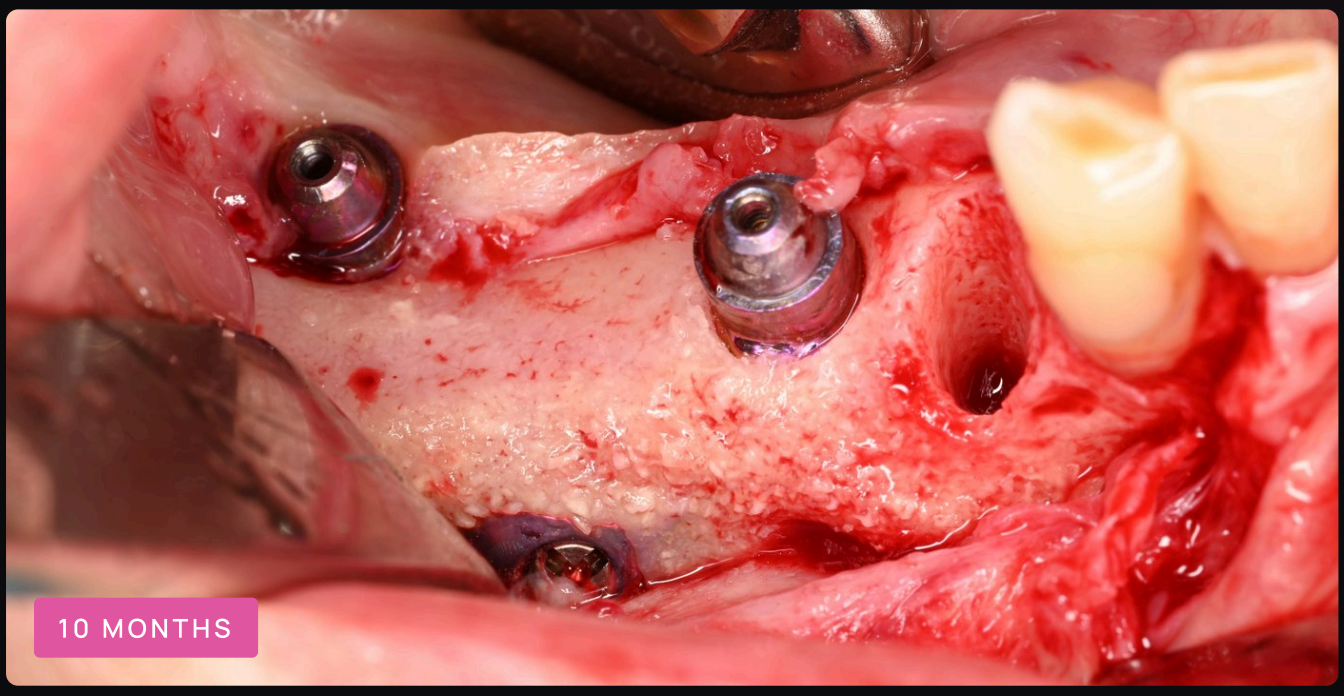
Dr Antoine Diss · Dr Laurine Birault

2026 EDITION

BONE OVER METAL, IN ONE CASE

Ten months later, bone covers the metal





Posterior mandible, one patient. Top: the implant on the day of surgery, its arms resting on the bone. Bottom: at re-entry ten months later, new bone covers the arms and only the abutments emerge.

> A single case, shown for illustration: how long this bone coverage lasts will only be known with long follow-up. Chapter 4 explains how it is obtained (Subperiosteal Institute).

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IN TWO MINUTES

- **Subperiosteal implants are back.** Since 2017, they are designed from a CT scan, printed in titanium and screwed to the bone.
- **They survive.** More than 95% are still in function two to three years after placement.
- **The gum is the weak point.** Framework exposure affects a quarter to a third of implants in recent reviews, and reported rates vary widely across clinical series.
- **The protocol decides.** Recession follows identifiable choices, and each one can be anticipated.
- **Bone over metal.** Covering the implant with bone gives the gum a living support: this is the intraosseous subperiosteal implant.
- **It can be learned.** With the right first case, a strict protocol and a structured training.

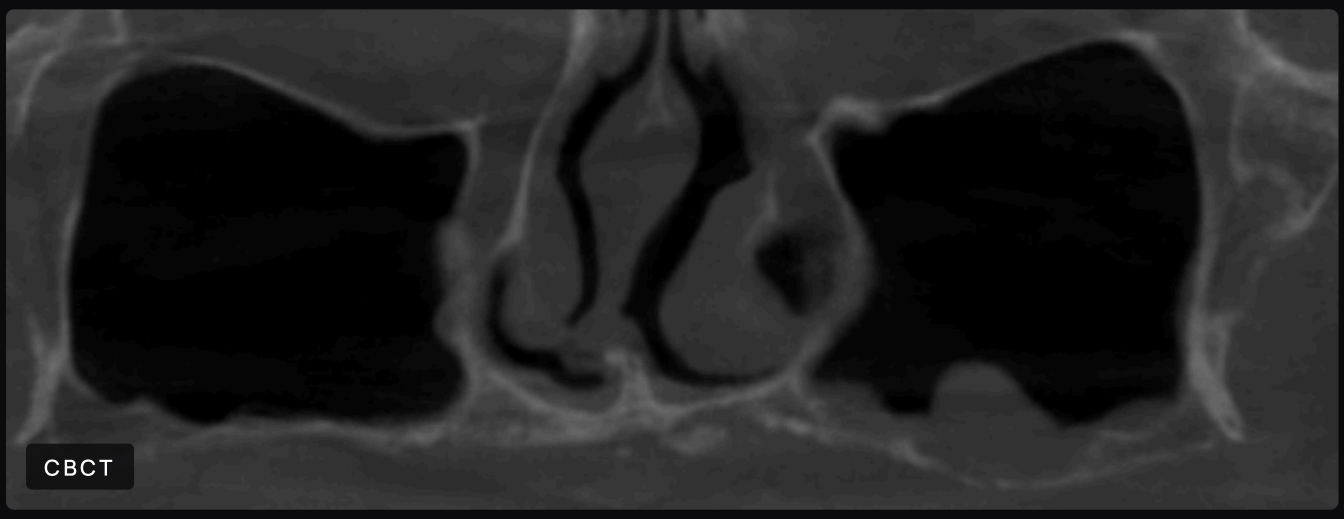
Conflict of interest — The authors are co-inventors of the HUG® subperiosteal implant (Biotech Dental). Every figure taken from the literature is cited; observations and figures from our own practice are labelled as such.

01

CHAPTER 1 · THE PATIENT

The patient we send away

Every implant surgeon knows this patient. She is in her seventies, her upper denture no longer holds, and the CBCT shows a few millimetres of bone beneath the sinuses and almost nothing in the premaxilla.



Panoramic reconstruction of a CBCT of an edentulous maxilla: large sinuses and only a thin layer of bone left beneath them (Subperiosteal Institute).

She is not rare. In a CT study of 228 edentulous arches in patients aged 65 to 100, only 5% of maxillae could receive implants without augmentation, and 64% needed major reconstruction in both the anterior and posterior regions (Cordaro et al. 2020). In Europe, complete edentulism at 65–74 years ranges from 6–20% in Spain, France and Italy to more than 40% in Poland and Romania (Gómez-Costa et al. 2026).

64%
MAJOR RECONSTRUCTION

5%
NO AUGMENTATION

Edentulous maxillae in patients aged 65 to 100: CT study of 228 arches (Cordaro et al. 2020).

The classic answers are heavy. Bone grafting means an extra surgery, months of waiting and a graft that may partly resorb; the techniques that gain the most bone are also those with the most complications (Alotaibi et al. 2023). Zygomatic implants avoid the graft, but they are invasive, operator-dependent and close to the sinus and the orbit. So many of these patients are referred elsewhere, or told that nothing more can be done.

Since 2017, a third path has come back: the subperiosteal implant, entirely redesigned by digital technology. This booklet shows what it is worth, why its weak point is the gum, and how covering it with bone changes the picture.

1.1 An implant is not yet a concept

1943
Dahl publishes the first subperiosteal frameworks

1985
The CT scan replaces the bone impression

2017
Digital revival: designed on screen, printed in titanium

Today
Bone over metal: the intraosseous concept

Subperiosteal implants are not new. Dahl placed the first metal frameworks beneath the periosteum in Sweden and published the concept in 1943 (Dahl 1943).

The first generation was cast in cobalt-chromium and simply laid on the bone. Ten-year survival ranged from 79 to 95% in the mandible and from 65 to 93% in the maxilla (Rinaldi and Mommaerts 2023). The frameworks rested on alveolar bone that kept resorbing, they were not fixed, and the posts crossing the gum let bacteria colonise the whole framework (Linkow and Ghalili 1999; Goh et al. 2025). In 1985 came the first implant made on a model of the jaw built from CT data: the surgical bone impression, and with it a second operation, could be avoided (Surovas 2019; Truitt et al. 1988).

Endosseous implants went through the same story. What changed with Brånemark was not only the metal: it was a concept, osseointegration, with a defined protocol, precise engineering and long follow-up (Adell et al. 1981). The digital revival of 2017 brought the engineering: implants designed from the CT scan, printed in titanium and screwed to the bone (Mommaerts 2017; Gellrich et al. 2017). One question remained open: what happens to the gum?



The digital revolution makes it possible to 3D-print complex structures, such as this gyroid lattice, designed to let bone grow into the implant: the printed titanium part and its design (Subperiosteal Institute).

KEY POINT

“

Technology has solved precision and fixation.

The concept was still missing.

CHAPTER 2 · THE EVIDENCE

What the literature says in 2026

Within two to three years of placement, more than 95% of modern subperiosteal implants remain in function. The systematic reviews published since 2024 agree on this point.

- **Anitua et al. 2024:** 227 implants, 97.8% in function after a mean 21.4 months.
- **Cosola et al. 2026:** 369 implants, 97.8% pooled survival with up to three years of follow-up.
- **Vaira et al. 2026:** the largest series, 211 implants, 98.1% survival at a median 28 months, with no framework or screw fracture.

With longer follow-up, the picture spreads: beyond five years, survival ranges from 54 to 97% depending on the team (Onică et al. 2024; Zielinski et al. 2025). We believe these wide differences come largely from the protocol. Protocols vary greatly from one team to another, and the series with the longest follow-up still rely on protocols that no longer meet current standards: bone reshaped by hand without a cutting guide, cemented prostheses. Precise guidelines do not exist yet; an expert consensus report was only published in 2024 (Herce-López et al. 2024).

2.1 The implants survive. The gum doesn't.

Every recent synthesis reaches the same conclusion: the most frequent complication is exposure of the framework, through recession or dehiscence of the gum. It affects 25.6% of implants in one review (Anitua et al. 2024), 28.6% in a meta-analysis (Tabrizi et al. 2026) and 37% in another review (Al-Nawas and Bär 2025), and it is the main cause of late failure (Cosola et al. 2026).

IN FIGURES

FRAMEWORK EXPOSURE IN TWO CLINICAL SERIES

Reported exposure rates vary widely across clinical series.

0%

of patients with an exposed framework

SITE	Posterior mandible
COUNTED	0 of 17 patients (30 implants)
FOLLOW-UP	Mean 22.5 months

Vaira et al. 2024

65%

of patients with an exposed framework

SITE	Maxilla
COUNTED	26 of 40 patients
FOLLOW-UP	About 2.5 years

Van den Borre et al. 2024

Site, patients and follow-up differ, so the two figures cannot be compared head to head. One likely explanation for the gap: the protocol.

The strongest clue comes from Pérez Salazar et al. (2026): when the team moved from implants with palatal anchorage, a plate screwed to the palate, to implants without palatal anchorage, exposure fell from 35% to 5% of patients.

KEY POINT

Recession is the most frequent complication, and the most variable from one team to another.

Which suggests it can be controlled.

03

CHAPTER 3 · THE GUM

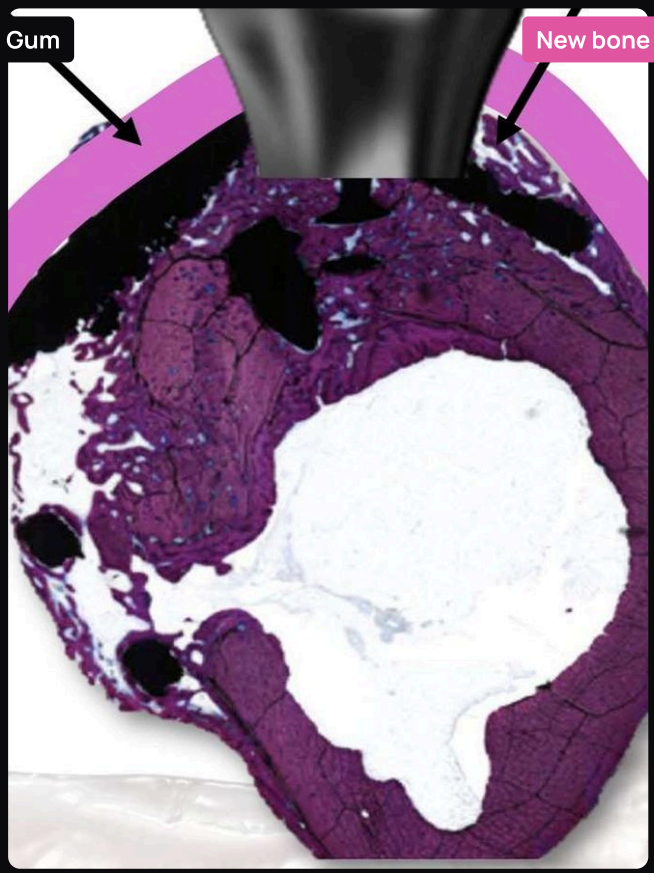
Why the gum recedes

Recession is not a fate of titanium. It starts with a simple question: what lies beneath the gum?

GUM ON METAL

No blood supply from below

The gum rests directly on the titanium arm. Nothing feeds it from underneath: the risk of recession is high.



GUM ON BONE

Vascular support restored

A thin layer of new bone covers the arm. The gum rests on living tissue: the risk of recession is low.

Histological section of a subperiosteal implant arm in an animal model. Adapted from the HUG® eBook (Diss and Birault 2026).

When nothing separates the gum from the framework, it rests on an avascular titanium surface that cannot feed it. When a thin layer of new bone covers the arm, the gum rests on living tissue, as it does over natural bone. The literature adds the factors that tip the balance:

- **A thin gingival phenotype**, the best-documented factor (Van den Borre et al. 2024; Van den Borre et al. 2025).
- **Smoking**, which multiplied the odds of recession almost sevenfold in one study, though without reaching significance (Van den Borre et al. 2024).
- **Residual alveolar bone that keeps resorbing** and leaves the arms bare (Rinaldi et al. 2020).
- **Palatal anchorage**, a metal plate screwed to the palate, under a thin mucosa that tolerates its pressure poorly (Pérez Salazar et al. 2026).
- **A crestal incision and flap tension**, which leave too little keratinised gum around the posts (Vaira et al. 2024; Al-Nawas et al. 2026).
- **A prosthesis that covers the gum** and traps biofilm (Jia and Yang 2024).

KEY POINT

Gum on metal has nothing to feed it. Gum on bone does.

So the goal is bone over metal.

CHAPTER 4 · BONE OVER METAL

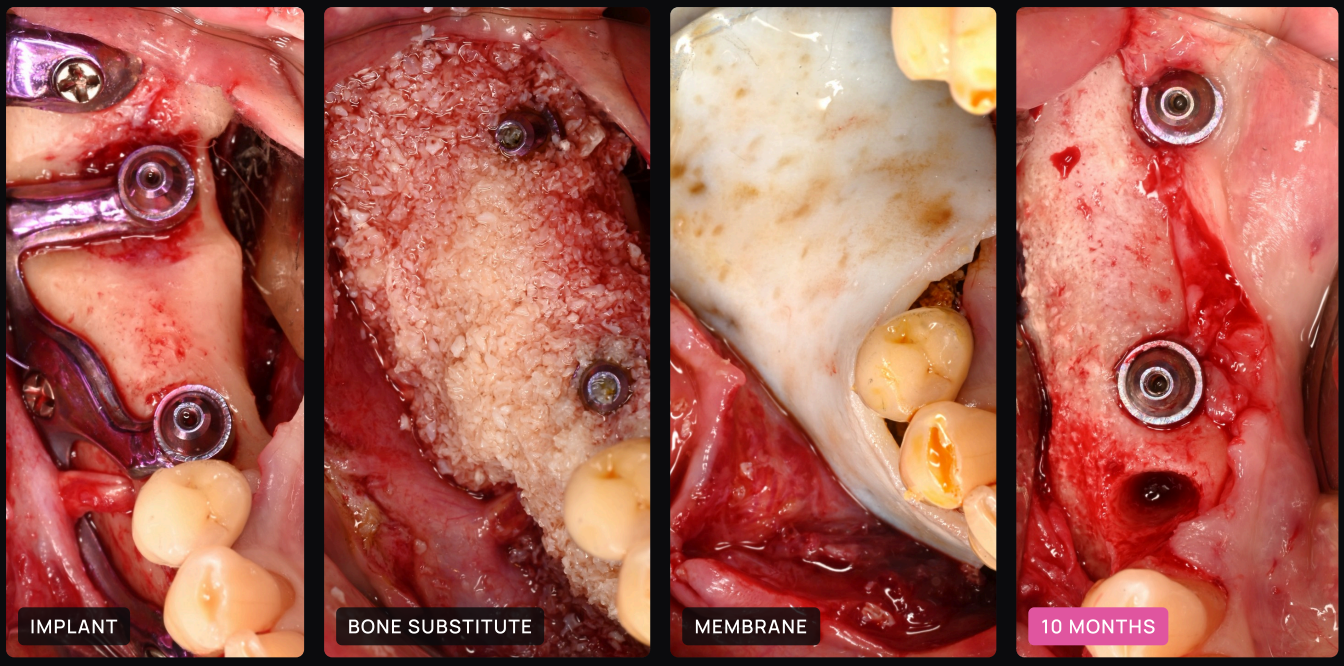
Bone over metal: the intraosseous subperiosteal implant

If recession is the weak point, the answer is to stop the gum from resting on titanium. Guided bone regeneration, used for decades around endosseous implants, shows the way: cover the framework with bone.

The idea has experimental roots. In rabbits, titanium subperiosteal implants covered with a bovine bone substitute and a membrane were all osseointegrated after 12 weeks (Aaboe et al. 2000). In patients, Vaira et al. (2026) found the framework partly or fully covered by bone when they reopened three implants. The posterior mandible shown on page 2 is one of our cases, reopened ten months after surgery.

4.1 Five principles to put bone over metal

1. **Seat the implant in the bone.** A custom cutting guide removes the resorbing crest down to stable basal bone and creates a recess where the implant sits partly inside the bone.
2. **Cover the whole implant.** A bone substitute goes over the framework during the same surgery, under a membrane or a dermal matrix. The screws hold the implant; the graft grows bone over the arms.
3. **Give the bone something to hold.** A gyroid lattice (50% porosity, 2 mm cells) and a crenellated edge keep the biomaterial in place and invite bone in.
4. **Let it heal buried when you can.** In partial cases, the implant is closed in completely and the abutments hold the membrane up like tent poles. They are uncovered four months later.
5. **Bring keratinised gum to the abutments.** Incision shifted towards the palate in the maxilla; connective tissue graft or dermal matrix in the mandible.



The case shown on page 2, step by step: the implant screwed to the bone, covered with bone substitute and a membrane, then reopened ten months later (Subperiosteal Institute).

These are clinical observations and early series: grafted bone can partly resorb, and only long follow-up will tell how durable this coverage is.

KEY POINT

"

We do not ask the gum to sit on titanium.

We give it bone.

CHAPTER 5 · BUILT TO LAST

Built to last, with fixed teeth on day one in full-arch cases

Covering the implant with bone protects the gum. The implant must also withstand years of chewing and, in full-arch cases, give the patient fixed teeth on the day of surgery.

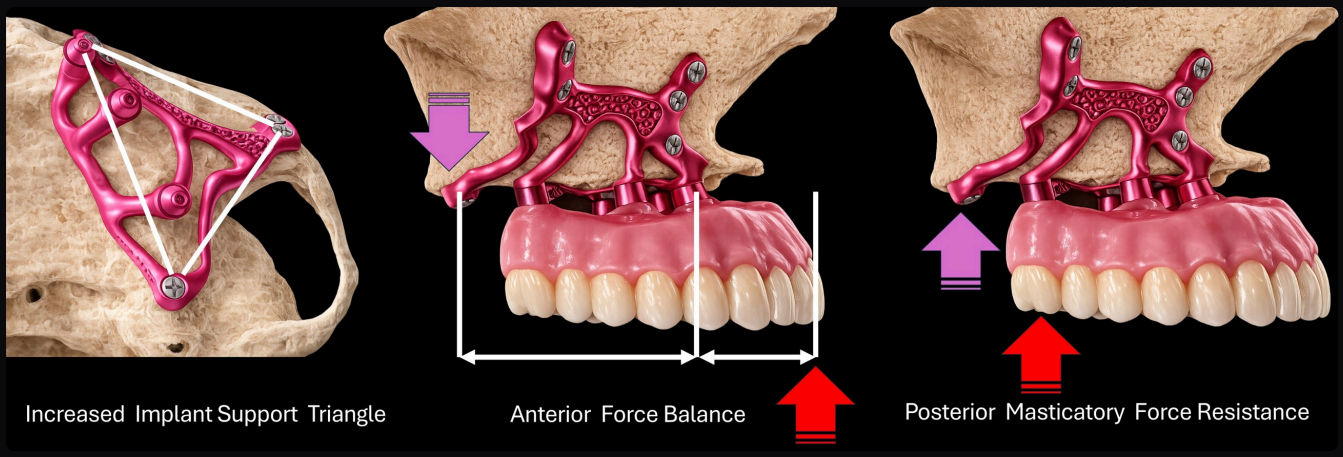
1.5 mm
ARM THICKNESS

50%
LATTICE POROSITY

6
ABUTMENTS, FULL ARCH

Design choices checked by finite element analysis (Subperiosteal Institute).

- **Finite element analysis for every patient:** each design is stress-tested before printing.
- **Pterygoid anchorage in every full-arch maxilla:** dense cortical bone, even in the most atrophic maxillae, against posterior chewing forces.
- **A palatal band, not screwed to the palate:** the implant rests on the palate without palatal anchorage screws.
- **Six abutments, part of the implant itself:** thinner arms, better load sharing, and no removable connection where bacteria could seep in.
- **A gyroid lattice in the plates:** 50% porosity and 2 mm cells that hold the graft and let new bone grow through the implant.
- **A flat peripheral lip:** a thin rim around each plate that lies flat on the bone, designed to encourage bone growth over the edge of the implant.
- **A pink anodised surface,** far less visible if an arm is ever exposed.



Pterygoid anchorage, three mechanical advantages: a wider support triangle for the implant, balanced anterior forces, and resistance to posterior chewing forces (Subperiosteal Institute).



FLAT PERIPHERAL LIP

Designed for bone to grow over the edge

Around each plate, a thin flat rim rests on the bone. With the lattice, it gives the graft a stable border and new bone a surface to grow over.

HUG® implants for the posterior mandible (3D rendering).

5.1 A definitive bridge on the day of surgery, in selected full-arch cases

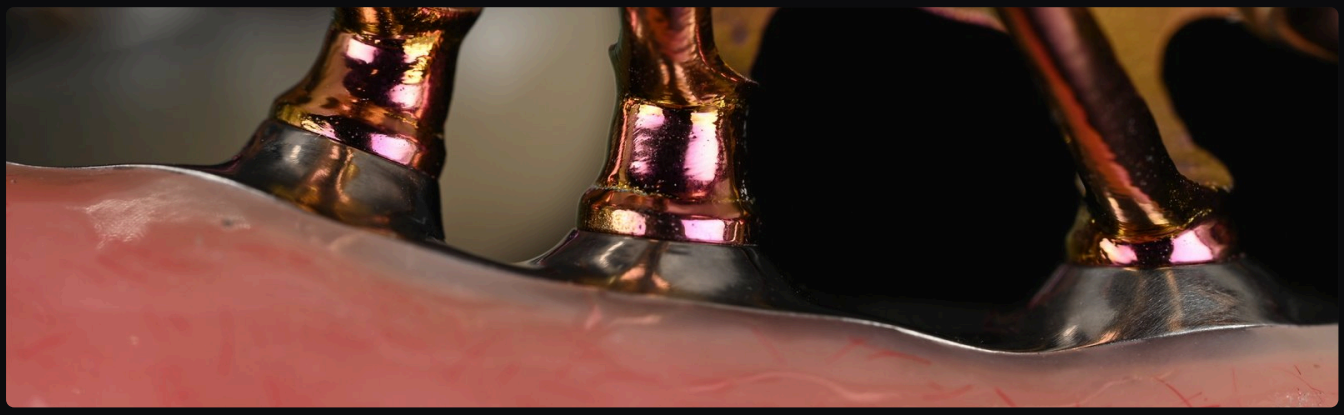
In full-arch cases, the bridge is definitive: a milled titanium framework with PMMA teeth, screw access in the centre of the teeth. The patient bites on it while the implant is fixed, and leaves with it. It stands on its abutments like a house on stilts, so the tissues are never compressed and the patient can clean underneath. In partial cases, a provisional bridge is supplied and the dentist's own laboratory makes the final one.



PASSIVE FIT

Seated without tension

Implants and bridge designed together. We design the implants and bridge from the same digital dataset so the titanium bridge framework can seat passively on the abutments.



Close-up of the perfectly passive fit: the definitive bridge and its milled titanium framework seat without tension on the six multi-unit abutments of the implants; three are visible here (Subperiosteal Institute).

5.2 One digital chain, one box

The surgeon sends the scans online, approves the wax-up, then the abutments and screws, then the final design in a 3D viewer. Everything arrives in one box: implant, cutting guide, resin model, replica and bridge, so the surgery is rehearsed before the sterile pack is opened. In our experience, about six weeks pass from the files to the surgery.

KEY POINT

“

Precise data give a passive fit.

In full-arch cases, a passive fit allows fixed teeth on day one.

CHAPTER 6 · SAFETY

Versus the alternatives, and if it ever fails

Before trying a new technique, every surgeon asks two questions. Is it safer than what I do today? And what happens if it fails?

Only one study has compared custom subperiosteal and zygomatic implants over at least five years, in 150 patients from a single centre (Zielinski et al. 2025).

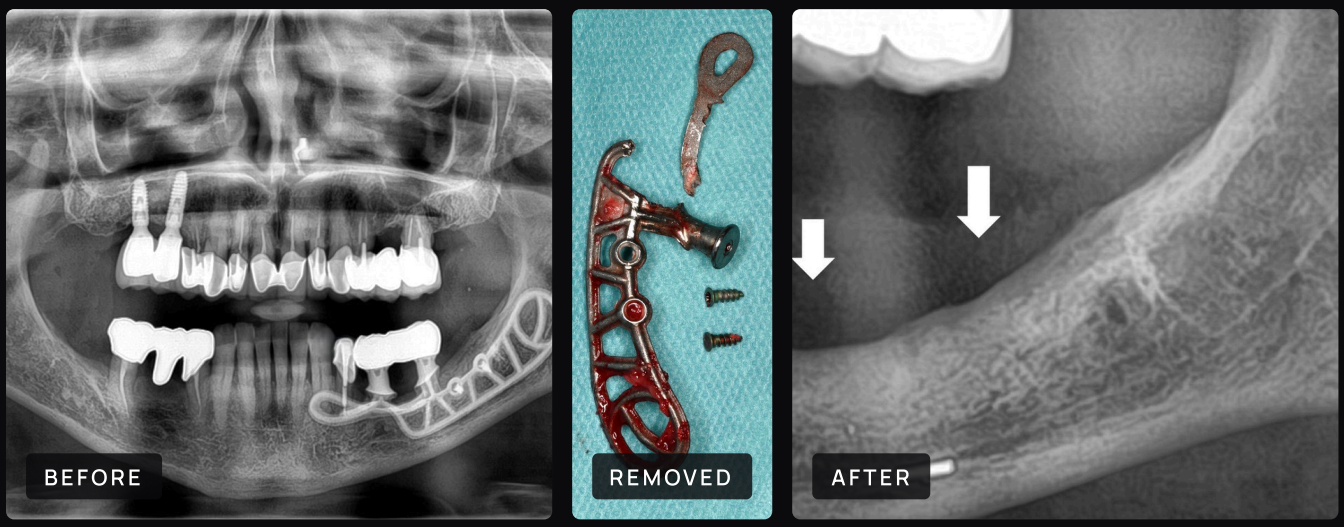
	SUBPERIOSTEAL	ZYGOMATIC
Implant survival	97.1%	96.3% (no significant difference)
Main complication reported	Peri-implantitis, 5.6%	Sinus complications, 12.4%
Soft-tissue recession	Less frequent	More frequent
If the implant fails	Re-implantation possible	Options more limited

The groups were not randomised, and the two complication rates do not concern the same event. But the logic holds: a subperiosteal implant stays outside the sinus and away from the orbit, and involves less morbidity than complex bone reconstruction (Herce-López et al. 2024).

6.1 What we found when we removed a digital subperiosteal implant

Historical implants were held by fibrous tissue: at the first infection they moved, and left severe bone loss. Modern implants are screwed to the bone. In our practice, we removed a digital subperiosteal implant from another manufacturer after 18 months and repeated infections, in about 40 minutes. It had never moved, and there was no significant bone loss beneath it. This is a major difference from cylindrical

implants, which lose bone along their whole surface. Zygomatic implants are also more operator-dependent and require more osteotomies. They are difficult to remove, and managing their complications belongs to maxillofacial surgery: middle meatal antrostomy for sinusitis, orbital penetration, extra-oral fistula.



Removal of another manufacturer's implant after 18 months in function: no significant bone loss (Subperiosteal Institute).

KEY POINT

A conventional or zygomatic implant takes bone with it when it comes out.

The subperiosteal implant we removed left it in place.

07

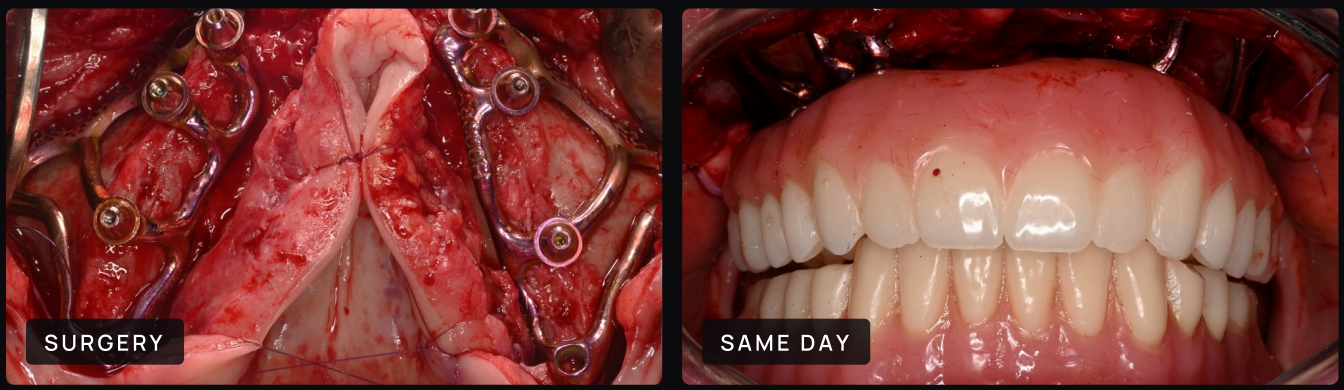
CHAPTER 7 · CASES

Two patients, the same principles

Two patients, two indications, the same logic: data first, bone over metal, fixed teeth as early as possible.

7.1 A full maxilla with no bone under the sinuses

A 72-year-old woman had virtually no bone beneath the sinuses or in the premaxilla, and an oroantral communication. Her denture was remade to validate the vertical dimension, then used for the dual-scan protocol. Two implants were fixed with the definitive bridge in occlusion and pterygoid anchorage on each side, then covered with bone substitute and PRF. She left the same day with her fixed bridge; at 18 months, the tissues around the six abutments were stable.



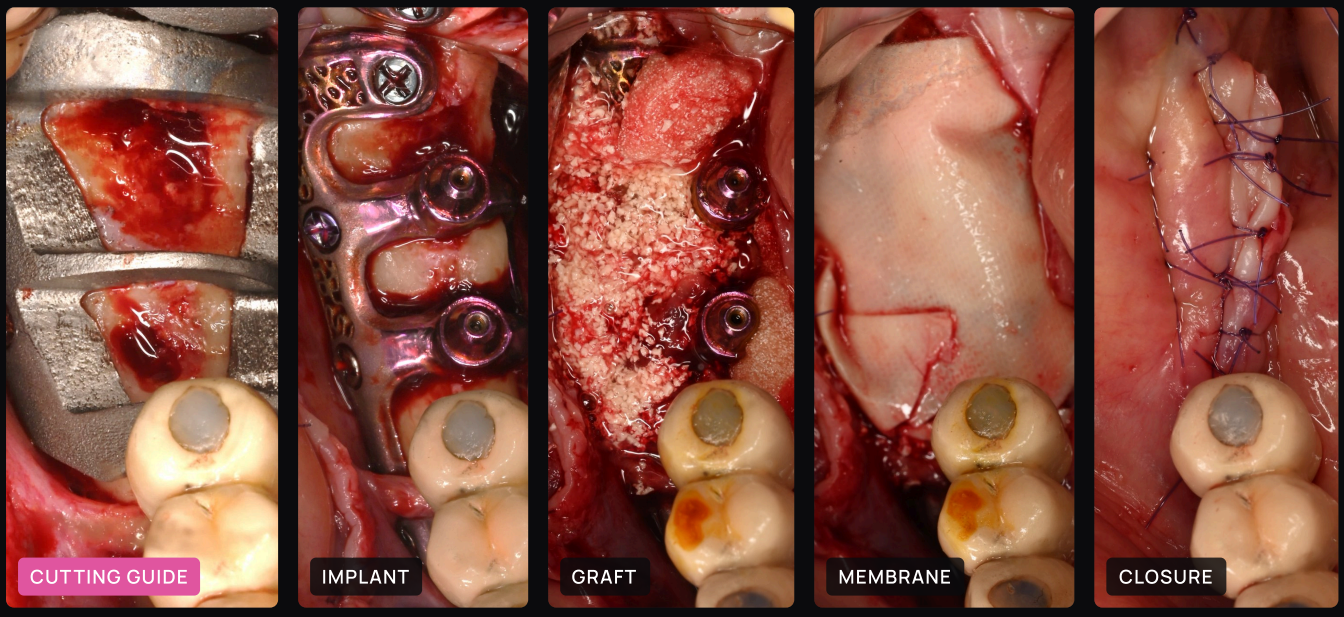
Day of surgery: the two implants in place, then the definitive bridge screwed in and in occlusion before the patient leaves (Subperiosteal Institute).



The maxilla before treatment, and the gum around the six abutments at 18 months, bridge removed (Subperiosteal Institute).

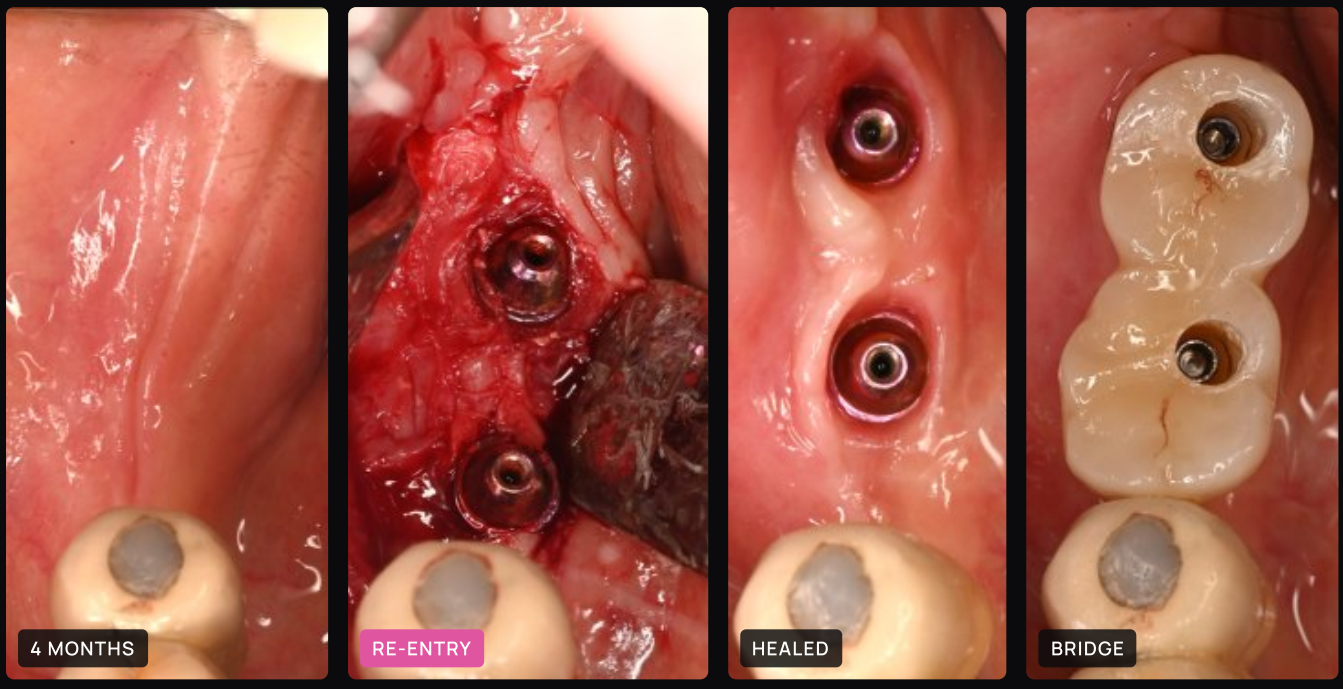
7.2 4.9 millimetres above the nerve

A 69-year-old patient had 4.9 mm of bone above the inferior alveolar nerve, with no bone peaks to support vertical regeneration. The treatment was planned in **two surgical stages**, and the first one started with a **cutting guide**.



Stage 1. The cutting guide removes the resorbing crest and cuts slots for the arms, so the implant sits partly inside the bone. The implant is then screwed in, grafted and covered with a membrane, and the gum is closed over the buried abutments (Subperiosteal Institute).

At re-entry four months later, new bone covered the arms, and the CBCT still showed it at one year.



Stage 2, four months later. The abutments are uncovered, the gum heals around them, and the bridge is screwed in (Subperiosteal Institute).

KEY POINT

Two patients who are usually referred elsewhere, treated with the same principles: data first, bone over metal, fixed teeth as early as the case allows.

One concept, several indications.

CHAPTER 8 · YOUR PROFILE

Which practitioner are you?

Four kinds of practitioners come to us. Their questions differ, and so does the right first step.

01 You refer your atrophic cases today

You see these patients every month, and you send them elsewhere.

"Is it worth bringing these patients back?"

Everything custom is designed and made for you, and arrives in one box. Start with a unilateral maxillary or mandibular case, then move to full arch as your confidence and experience grow. You will boost your practice and stop losing patients to other practices.

02 You already place zygomatic implants and grafts

You have already seen a sinus graft fail, or a zygomatic implant end in chronic sinusitis.

"What do you offer when they fail?"

You give nothing up. You add an option where zygomatic implants and grafts are at their hardest: chronic sinus disease, oroantral communications, failed sinus grafts. Your grafting skills are an asset.

03 You plan every case digitally

You already plan every implant on screen before you pick up a drill.

"How far does the digital chain go?"

All the way to the operating room: dual-scan data, finite element analysis, a 3D viewer, a guide and a replica.

04 You are a maxillofacial surgeon

You are at ease with complex surgery, but the prosthesis usually depends on someone else.

"And the prosthesis?"

It comes with the implant: in full-arch cases, the definitive bridge is in the box and screwed in on the day of surgery. Much of this literature comes from maxillofacial teams (Korn et al. 2021; De Riu et al. 2025).

> ALREADY PLACING ANOTHER SUBPERIOSTEAL IMPLANT?
>
> We start with a conversation, to understand what you do today and avoid repeating what did not work. The e-learning then teaches the protocol before your first HUG case.



WHO COMES TO US

Four profiles. One protocol.

Dr Antoine Diss presenting the HUG® concept, Kontact™ Symposium 2026, Vietnam.

8.1 Who it is for

- **Not a first implant course:** you should already master a lateral sinus lift, a full arch on six implants with immediate loading, and a connective tissue graft.
- **The right first case:** a full maxilla, or a partial maxilla or mandible. Not a full mandible.
- **The right patient:** over 60, after weighing benefit and risk, with a severely resorbed jaw or a contraindication to grafting, a non-smoker with good oral hygiene. For these patients, one surgery can mean fixed teeth again.
- **Time in surgery:** about 2 h 30 to 3 hours for a full-arch maxilla; about 1 h 20 for the first stage of a partial case.

09

CHAPTER 9 · TRAINING

Learn the HUG technique

Learn how to select a suitable first case and review the digital plan. During the hands-on day, you'll use the cutting guide, place two implants and seat the bridge yourself on a 3D-printed model of a resorbed maxilla.

View course dates and register →

Have a patient in mind? Discuss your case with Dr Diss

ON-SITE COURSES 2027 · IN ENGLISH · TAP A DATE TO REGISTER

18 JANUARY	15 MARCH	24 MAY	20 SEPTEMBER	13 DECEMBER
Paris ›	Nice ›	Paris ›	Nice ›	Nice ›

ONE COURSE, EVERY LANGUAGE

Taught in English. Translated live into your language.

The hands-on day is delivered in English, with simultaneous AI translation into each participant's language. The e-learning is available in nine languages.

9.1 Why a hybrid course

01 · FIRST, ONLINE

E-learning, at your own pace

- Seven hours in 13 modules, in nine languages.
- One year of access: come back to a module before each case.
- You arrive at the course with the theory already in place.

→

02 · THEN, IN PERSON

One day for practice

- Commented videos of several cases, focused on the key steps and the pitfalls.
- Hands-on work with the cutting guide on a resorbed maxilla model.
- Your own cases, discussed with the trainers.



HANDS-ON DAY · NICE OR PARIS

Rehearse every step before your first patient.

Hands-on practice on 3D-printed resorbed maxillae.

HUG Concept Workshop 2026 (Subperiosteal Institute).

9.2 Also included

1. **Help with your first case:** a full maxilla, or a partial maxilla or mandible. We help you choose it, before or after the course; you do not need a patient to register.
2. **The HUG® eBook,** 115 pages on the whole concept, with four clinical cases.
3. **A community app** to post your cases, ask questions and find updated protocols, with a live webinar every three to four months.
4. **A communication kit:** a presentation, e-mail sequences and PDF documents to introduce HUG to your referring dentists.

> The HUG® concept is detailed, and very different from what you already know. Coming to a course without the basics means spending the day on questions. The e-learning lets you understand the concept first, so the hands-on day is kept for practice.

9.3 The e-learning, module by module

01 **Introduction and indications**
From the first frameworks to CAD/CAM designs, and when the implant is indicated.

02 **Literature review**
Survival, complications and clinical trends in recent studies.

03 **The nine pillars**
Design, surface, lattice and biomechanics: what makes the implant intraosseous.

04 **Patient preparation**
Medical work-up, premedication and biological optimisation before surgery.

05 **Data submission**
Dual scan, prosthetic preparation and STL/DICOM transfer.

06 **Design validation**
Three steps on the MedPrint platform: wax-up, abutments and screws, guide and implant.

07 **Anaesthesia and flap**
Local anaesthesia, flap design and suturing, protecting anatomical structures.

08 **The cutting guide**
Preparing the basal bone so the implant sits partly inside it.

09 **Fixation**
Screws, anchorage sites and bicortical stability, with their anatomical risks.

10 **Tissue management**
Bone grafting, soft-tissue thickening and post-operative care.

11 **Complications**
Prevention, diagnosis and treatment, from infection to peri-implantitis.

12 **The prosthesis**
Impressions, including photogrammetry; definitive titanium bridges and PMMA provisionals.

13 **Clinical cases**
Commented surgical videos of the four main indications.

WHAT PARTICIPANTS SAY

★★★★★ **22 reviews on Trustpilot, all 5 stars** (November 2026) ›

★★★★★
"The course is well structured, highly practical, and immediately applicable in daily practice."
David Josef Melner · FR

★★★★★
"It's a very well-organized course that takes care of every detail."
Edgar Cabrera · ES

★★★★★
"Thoroughly enjoyed the online learning and the hands on course."
M. Amar · GB

★★★★★
"Excellent training for Subperiosteal Implants. Loved every bit of training!"
Pravin Kadam · GB

★★★★★
"Very well organized course. Highly advised"
Philip Jonsson · ES

★★★★★
"Very interesting new concepts. Highly recommended"
Alvaro C. Reuter Mullor · ES

9.4 A growing international community

More than 200 surgeons have followed the training so far, from Vietnam to Spain, and the HUG community now reaches South Africa, the Netherlands and the United Kingdom (November 2026).

FRANCE · VIETNAM · SPAIN · UNITED KINGDOM · SOUTH AFRICA · NETHERLANDS · GERMANY · ITALY · BELGIUM · PORTUGAL · IRELAND · ROMANIA · BULGARIA · ALBANIA · UNITED STATES



Top: the HUG Concept Workshop in Hanoi, 27 October 2026. Below: hands-on work on 3D-printed jaw models and diploma days, in Nice and Hanoi (Subperiosteal Institute).

Dr Antoine Diss

DDS, PHD · ORAL SURGEON, NICE



I am an oral surgeon with a PhD in Science. My doctoral research focused on PRF from 2002, at the very beginning of the concept. It took me to UCLA for my first international lecture in 2005, and led to several international publications, including the 2006 series that introduced PRF.

Bone has been the common thread ever since: first regenerating it, then treating the patients who no longer have enough of it. In 2023, this led me to digital subperiosteal implants and to the HUG® concept with Dr Laurine Birault, co-author of this guide. We have since published two international papers on pterygoid anchorage for subperiosteal implants, and many more are in the pipeline for 2027.

More about me on subperiosteal.com →

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Dr Antoine Diss
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CO-INVENTOR OF HUG®

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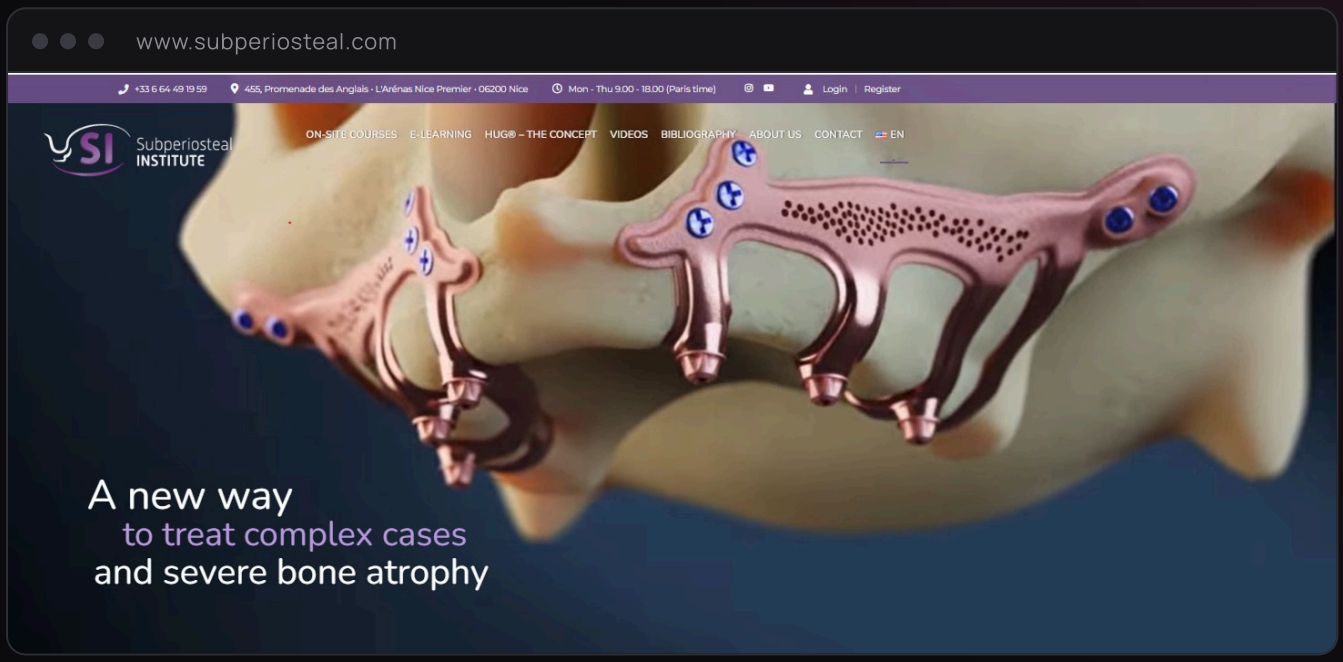
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Publications analysed

The literature on subperiosteal implants, summarised and sorted by topic: clinical studies, complications, finite element studies, osseointegration.

9

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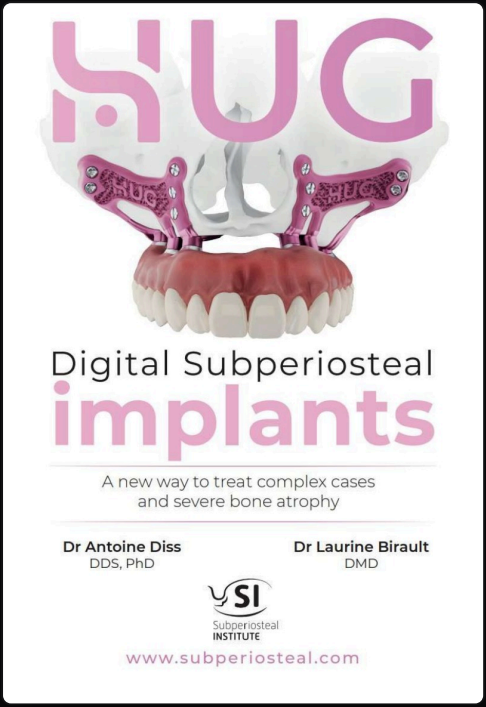
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A design that invites bone
Gyroid lattice with 50% porosity and a flat peripheral rim.

02
Surface and anodisation
Pink anodised titanium, smooth or rough depending on the tissue it meets.

03
A biomechanical study
Finite element analysis delivered with every implant.

04
Pterygoid anchorage
More support in the maxilla, against anterior chewing forces.

05
The cutting guide
Bone adapted to the implant, part of the implant set in the bone.

06
Tissue management
Bone graft over the implant, thicker soft tissue around the abutments.

07
PMMA replicas
Rehearse the surgery on a model of the patient before the day.

08
The prosthesis
A definitive bridge on the day of surgery in full-arch cases.

09
A secure digital workflow
An online platform, the Medprint® 3D viewer and a full surgical report.

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