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The ROOTT P Pterygoid Implant: A 12-Year Clinical Perspective on Macro design, Surgical Protocol, and Graftless Rehabilitation of the Atrophic Posterior Maxilla

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Abstract

Background: Posterior maxillary atrophy—often aggravated by sinus pneumatisation and low-density bone—remains a major clinical challenge in oral implantology. Conventional sinus augmentation and bone grafting procedures increase patient morbidity, financial cost, and treatment duration. Pterygoid implants provide a predictable graft-less alternative by anchoring into the dense cortical bone of the medial pterygoid plate.

Purpose: To evaluate the unique macro-design features of the ROOTT P (Pterygoid implant), outline its surgical protocol, and review 12 years of clinical evidence supporting its application in posterior maxillary rehabilitation.

Methods: Narrative clinical review and literature analysis, synthesized with a 12-year clinical perspective on the ROOTT P implant.

Results: The ROOTT P implant demonstrates high anatomical adaptability, suitable for approximately 98% of posterior tuberosity morphologies. Its graduated, three-zone thread architecture consistently yields primary insertion torques of 50–70Ncm. Clinical studies report cumulative survival rates ranging between 92.5% and 100% over follow-up periods extending up to 10 years.

Conclusion: The ROOTT P system offers a reliable, minimally invasive, graftless rehabilitation option for the severely atrophic posterior maxilla, combining targeted thread geometry with immediate-loading capabilities.

Keywords
ROOTT P; Pterygoid Implant; Surgical Protocol; Graftless Rehabilitation; Atrophic Posterior Maxilla.

Introduction
The posterior maxilla presents a notoriously difficult biomechanical environment for dental implant placement. Rapid resorption of the alveolar ridge following tooth loss, compounded by progressive pneumatisation of the maxillary sinus, frequently leaves insufficient residual vertical bone height. Furthermore, bone density in this region is routinely compromised, often corresponding to Misch D3 or D4 classification (thin cortical bone with sparse trabecular core).

Historically, overcoming these biological barriers required complex bone augmentation procedures, most notably lateral-window sinus floor elevation. While these techniques are documented, they carry inherent surgical risks, prolonged healing phases (typically 6–9 months), higher financial burdens, and increased postoperative morbidity. For elderly or medically complex patients, extensive bone grafting may be contraindicated.

Pterygoid implants offer a graftless solution by utilising remote anchorage in the dense cortical bone of the pterygoid process of the sphenoid bone and the pyramidal process of the palatine bone. Originally proposed in the early 1990s, the concept required bridging two distinct anatomical environments: soft, trabecular tuberosity bone and dense, cortical pterygoid bone. Twelve years ago, in clinical collaboration with ROOTT AG (Switzerland), the ROOTT P (Pterygoid implant) was developed specifically to optimize this transition through an innovative hybrid macro-design.

Implant macro-design & engineering rationale
The ROOTT P implant is fabricated from high-strength Ti-6Al-4V ELI titanium alloy. Its surface is sandblasted with hydroxyapatite/tricalcium phosphate (HA/TCP) ceramic particles and acid-etched, producing a micro-roughened surface topography that facilitates rapid osseointegration and stable secondary stability.

The implant is manufactured in two diameters (Ø3.5 mm and Ø4.5 mm) across six lengths (16, 18, 20, 22, 24, and 26 mm). In routine clinical practice, the 20 mm length serves as the primary standard, providing reliable apical engagement in the pterygoid plate while maintaining a favourable restorative emergency profile.

Figure 1: ROOTT P Implants: Lengths 16 mm to 26 mm.

Figure 2: O – occlusal diameter (mm); I – intraosseous diameter (mm); a – apical diameter (mm); n – neck diameter; a – total internal angle (0); s- intraosseous square area (mm2); I = internal.

- Coronal Zone --> Broad threads deliver maximum compression at tuberosity crest
- Body Zone --> Thick, bold threads condense soft D3/D4 trabecular bone
- Apical Zone --> Thin, sharp self-tapping threads engage D1/D2 pterygoid plate

The three-zone thread architecture

The core innovation of the ROOTT P implant lies in its graduated, three-zone thread profile designed specifically for the varying bone densities along the pterygomaxillary trajectory:

1. **Apical Zone (3–4 mm):** Features fine, sharp, self-tapping threads engineered to penetrate and lock into the dense D1–D2 cortical bone of the medial pterygoid plate. The sharp apex acts as the "driving element", guiding the implant trajectory toward the cortical plate even in challenging visibility conditions.
2. **Body Zone:** Incorporates bold, thick, highly compressive threads designed to condense soft trabecular bone (D3–D4) within the maxillary tuberosity rather than cutting it away. This lateral compression enhances local bone density and primary stability.
3. **Coronal/Crestal Zone:** Features broad, wide-profile threads that optimize compression at the tuberosity crest, spreading occlusal stresses evenly over the coronal interface.

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Monobloc prosthetic architecture
The ROOTT P is a monobloc (one-piece) implant featuring an integrated multi-unit prosthetic connection.

- **Micro-gap Elimination:** Removing the fixture-abutment junction eliminates the bacterial micro-gap, significantly reducing peri-implant marginal bone loss and inflammatory complications.
- **Prosthetic Flexibility:** Features a 3 mm tissue cuff, a narrow Ø4.5 mm prosthetic platform, and a 30° angled neck allowing up to **60° total divergence/convergence** between implant axes.
- **Enhanced Screw Stability:** Incorporates an oversized **Ø2.5 mm fixation screw** (compared to standard 1.6–1.8 mm screws), offering superior resistance against bending moments and occlusal fatigue.

Pterygomaxillary Anatomy & Density Gradients
Successful execution of pterygoid implantology demands precise anatomical understanding. The trajectory passes through the maxillary tuberosity, crosses the suture line into the pyramidal process of the palatine bone, and anchors into the medial plate of the pterygoid process.

Key Anatomical Consideration: CBCT quantitative analyses confirm that bone density in the pterygoid plate region (mean 602.9–661.2 HU) is approximately 139.2% higher than in the maxillary tuberosity (mean 285.8–329.1 HU).

Because low-density tuberosity bone provides limited resistance, implants lacking dedicated apical cortical engagement risk early mobility. The ROOTT P design intentionally bridges this gradient, gaining primary mechanical stability from the dense posterior cortex while compacting the softer tuberosity bone along its body.

Surgical Protocol: The "Soft Technique"
The surgical protocol for the ROOTT P implant emphasizes maximum bone preservation and tactile control.

Key protocol steps
- **Landmark Mapping:** Preoperative CBCT assessment identifies the tuberosity, the hamular
- line (representing the anterior limit of the pterygoid plate), and the pterygopalatine fossa to establish a safe insertion pathway.
- **"Pilot-Drill-Only" Osteotomy:** In atrophic sites, a single pilot drill is utilised to create the initial trajectory. Sequential widening drills are avoided to preserve thin trabecular walls. The self-tapping threads of the implant perform the final osteotomy shaping during insertion.
- **Low-Speed / Manual Insertion:** Implants are inserted at 600 rpm or manually with a ratchet, usually without copious irrigation. This provides tactile feedback when the apical tip contacts and engages the hard pterygoid cortex.
- **Angulation:** The standard trajectory is oriented at 45° to the occlusal plane, directing the

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- implant apex toward the root of the medial pterygoid plate while maintaining the prosthetic platform within the functional dental arch.
- **Immediate Loading (Bone Truss Bridge Protocol):** Insertion torques of 50–70 Ncm are routinely achieved. When combined with anterior/premolar implants under the Bone Truss Bridge (BTB) protocol, full-arch definitive prostheses can be delivered immediately or within 2–3 weeks.

Clinical Evidence & Long-Term Outcomes

The clinical efficacy of the ROOTT P implant is supported by prospective, retrospective, and multi-centre clinical surveillance studies, alongside systematic review data across modern pterygoid implantology.

Summary of key clinical evidence

Study / Source	Design / Sample	Follow-up	Survival / Outcomes
ROOTT PMCF Surveillance Study	Multi-centre cohort (ROOTT P subgroup)	Ongoing	**98.75%** cumulative survival; zero abutment fractures reported.
Droubi & Zenati (2025)	Prospective trial (15 patients, 45 implants)	12 months	**100%** survival rate under immediate loading protocols.
Erbil Dental Journal (2025)	Retrospective cohort (58 patients)	2018–2024	**100%** survival across unilateral and bilateral configurations.
Bidra et al. (2022)	Systematic review (911 roughened implants)	Mean 6 years	**95.5%** cumulative survival rate.
ROOTT PMCF Surveillance Study	Multi-centre cohort (ROOTT P subgroup)	**Ongoing**	**98.75% cumulative survival; zero abutment fractures reported.**
Droubi & Zenati (2025)	Prospective trial (15 patients, 45 implants)	**12 months**	**100% survival rate under immediate loading protocols.**
Erbil Dental Journal (2025)	Retrospective cohort (58 patients)	**2018–2024**	**100% survival across unilateral and bilateral configurations.**
Bidra et al. (2022)	Systematic review (911 roughened implants)	**Mean 6 years**	**95.5% cumulative survival rate.**

Clinical Summary & Advantages

Over 12 years of clinical application, the ROOTT P implant has demonstrated several distinct clinical advantages:

1. **High Anatomical Adaptability:** The unique macrodesign adapts to approximately 98% of posterior maxillary anatomies, including severely resorbed or fatty tuberosities.
2. **Conservative Surgical Workflow:** The single-drill protocol preserves existing bone volume and minimizes surgical trauma.
3. **High Primary Stability:** Compressive body threads paired with sharp apical engagement reliably yield torques between 50 and 70 Ncm, facilitating immediate loading.

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4. **Reduced Mechanical & Biological Complications:** Monobloc construction removes connection micro-gaps, while the Ø2.5 mm fixation screw provides robust resistance to heavy posterior occlusal forces.

Conclusion

The ROOTT P pterygoid implant provides an evidence-based, graft-less treatment option for the severely atrophic posterior maxilla. By matching thread geometry to the specific anatomical bone densities along the pterygomaxillary path, the system consistently yields high primary stability suitable for immediate loading protocols. Twelve years of clinical perspective and emerging multi-center clinical data confirm that the ROOTT P implant offers a predictable, minimally invasive alternative to complex bone grafting procedures in modern dental implantology.

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