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ORIGINAL ARTICLE

Evaluation of Quality of Life After Placement of Glabellar Implant-Supported Prosthesis in Maxillectomy Cases

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Abstract

Purpose Extensive maxillary defects following maxillectomy significantly impair oral function, facial aesthetics, and psychosocial well-being. Conventional obturators often provide inadequate retention in large defects. Implant-supported rehabilitation using remote cortical anchorage sites has emerged as a feasible alternative. This prospective exploratory pilot study descriptively assessed short-term clinical trends and quality-of-life changes in patients rehabilitated with tripodized corticobasal® implant-supported prostheses incorporating glabellar implants.

Methods and Material Fifteen patients with maxillary deficiency or post-maxillectomy defects underwent corticobasal® implant placement in the glabellar, zygomatic, and/or pterygoid regions using a standardized protocol. Pain (VAS), implant stability (Periotest and resonance frequency analysis), and oral health–related quality of life (Hindi OHIP-14) were assessed preoperatively and at 24 h, 1 week, 4 weeks, and 12 weeks postoperatively. Changes across follow-up were analyzed using repeated measures analysis of variance (RM-ANOVA).

Results A statistically significant reduction in postoperative pain was observed over the follow-up period. Implant stability parameters demonstrated progressive improvement during healing. All OHIP-14 domains showed marked improvement, with substantial reduction in functional, physical, psychological, and social impact scores by 12 weeks.

Conclusion Within the constraints of a short-term single arm exploratory pilot design, rehabilitation incorporating a glabellar implant was feasible and associated with early clinical and quality-of-life improvement. Controlled long-term studies are required to establish durability and comparative effectiveness.

Keywords Glabellar implant · Corticobasal® implant · Tripodization · Maxillectomy rehabilitation · Quality of life · OHIP-14.

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Introduction

Maxillofacial defects following trauma, tumor resection, or infection compromise speech, mastication, respiration, aesthetics, and psychosocial well-being [1]. Rehabilitation options include surgical reconstruction with grafts or flaps and prosthetic obturators. Although obturators restore speech and swallowing, retention and stability decline in extensive maxillary defects [2, 3, 14]. Surgical reconstruction improves structural integrity; however, functional recovery may remain limited [15].

Severe maxillary deficiency often limits conventional implant placement because of inadequate bone volume. Corticobasal® implants engage remote cortical anchorage sites such as the zygomatic, pterygoid, and glabellar regions, enabling stabilization in compromised anatomy.

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Tripodization distributes functional forces across multiple cortical supports to improve biomechanical balance.

Glabellar implants provide anterior cortical anchorage when combined with posterior support [5–9]. Clinical outcome data on glabellar implants in maxillectomy rehabilitation remain limited in the literature, supporting the relevance of the present exploratory pilot study. This study evaluates short-term clinical trends and quality-of-life outcomes following rehabilitation incorporating a glabellar implant in maxilla-deficient patients.

Subjects and Methods

The prospective exploratory pilot study was conducted in the Department of Oral and Maxillofacial Surgery, King George's Medical University, Lucknow. Indications for incorporation of a glabellar implant included severe maxillary deficiency with inadequate anterior support, absence of sufficient palatal bone for conventional implant anchorage, and favorable frontal sinus anatomy confirmed radiographically. Exclusion criteria included refusal to give consent; chronic debilitating conditions, bisphosphonate therapy; history of head and neck radiotherapy in the previous 18 months; any evident pathology; pregnancy; physical disorders interfering with oral health maintenance.

This study was designed as a prospective exploratory pilot series. Fifteen consecutive patients meeting clinical indications for glabellar implant placement were included. A formal sample size calculation was not performed, as the study aimed to generate preliminary data on feasibility and short term outcomes.

All procedures were performed using a standardized protocol under local anesthesia. The glabellar region was palpated and the drilling site determined. For the glabellar approach, osteotomy was performed using tapping to minimize surgical trauma. Trajectory planning was guided using preoperative imaging to avoid the frontal sinus, orbit, and anterior cranial base. The path was planned from the maxillary canine alveolar region toward the frontal beak. The drill was guided using a handheld instrument and once the mineralized bone near the frontal beak was reached, tapping was performed to achieve cortical engagement of 5 mm. The implant was then inserted along the same trajectory to engage the glabellar cortical region. This technique requires precise anatomical knowledge and surgical expertise. It is splinted with existing zygomatic and pterygoid implants placed distally [4, 5, 7, 10, 13, 24].

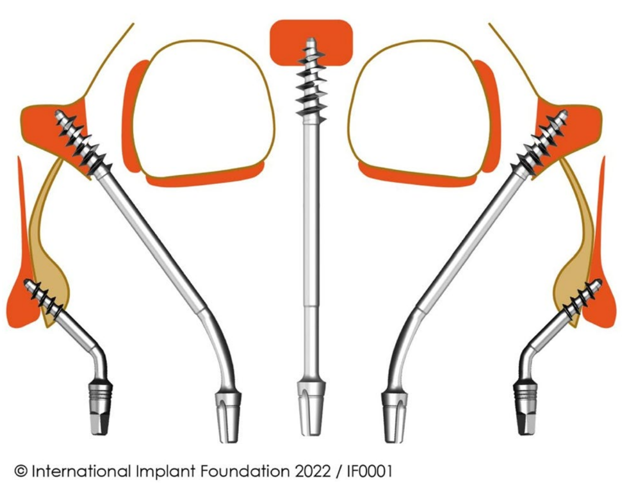

Fig. 4 Schematic representation of tripodization concept showing anterior cortical anchorage using a glabellar implant combined with posterior support from zygomatic and pterygoid implants

All surgeries were performed by an experienced surgeon using ZDI® and BECES® implants (Simpladent GmbH, Switzerland). Figure 4 schematically illustrates the concept of tripodization using glabellar, zygomatic and pterygoid implants [7].

Postoperative management included antibiotics, anti-inflammatory agents, and antiseptic mouthwash and dietary instructions. Prosthetic loading was completed after framework verification.

Follow-up was scheduled at 24 h, 1 week, 4 weeks and 12weeks. Immediate postoperative NCCT confirmed implant positioning. Pain was assessed using VAS(0–10), and implant stability assessment by resonance frequency analysis (RFA; Osstell device) and Periotest. Quality of life was evaluated using the Hindi OHIP 14 questionnaire.

Data were analyzed using repeated measures analysis of variance (RM-ANOVA) to evaluate changes across time points. Assumptions of normality and sphericity were assessed, and where violations were identified, appropriate corrections were applied. In cases where parametric assumptions were not met, non-parametric alternatives were used for pairwise comparisons. Where applicable, mean differences with corresponding 95% confidence intervals were calculated for paired parametric comparisons. Statistical significance was set at $p < 0.05$. Given the exploratory pilot design, results were interpreted as temporal trends rather than confirmatory evidence. Due to the small sample size and repeated-measures design, effect size estimates may be inflated and should be interpreted with caution

Results

A statistically significant reduction in pain scores over time was observed using repeated measures analysis ($p < 0.001$). Mean VAS values declined from 4.60 ± 2.32 at 24 h to 0.60 ± 0.91 at 12 weeks.

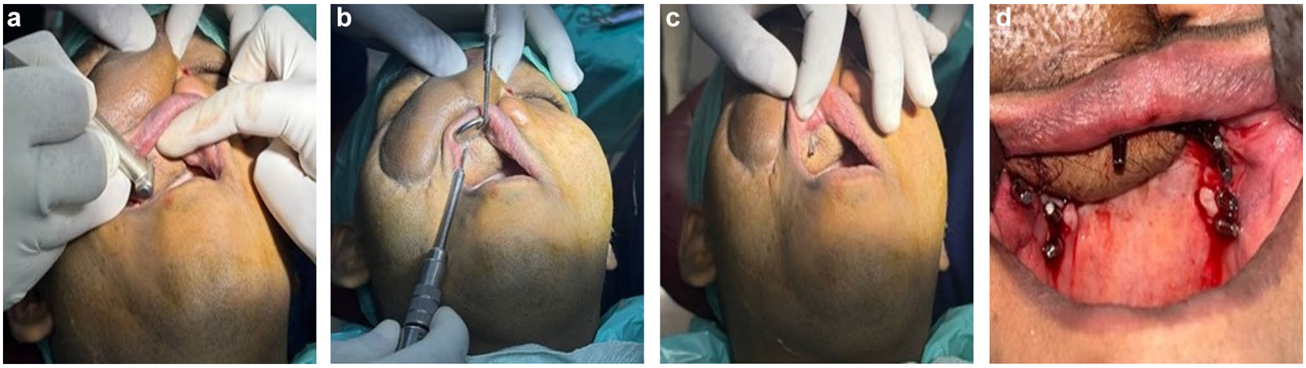

Fig. 1 Intra operative pictures. **a** palpation of glabellar region followed by use of drill, **b** use of hand driver to place glabellar implant, **c** placement of glabellar implant, **d** placement of glabellar, zygomatic and pterygoid implants

Fig. 2 Pre operative pictures. **a** intraoral picture, **b** frontal view, **c** NCCT 3D image, **d** NCCT sagittal view of glabellar region

Implant stability assessed by Periotest showed significant variation across time points (RM-ANOVA, $p < 0.001$). An initial increase in mobility at 4 weeks (mean change 2.60; 95% CI 1.56–3.64) was followed by improved stability at 12 weeks (mean change −2.53; 95% CI −3.57 to −1.49), consistent with biological osseointegration (Tables 1, 2 and 3).

RFA values increased from 62.93 ± 4.23 immediately post-placement to 69.53 ± 0.64 at 12 weeks (paired t-test, $p < 0.001$), with a mean increase of 6.60 (95% CI 4.38–8.82), indicating improved implant stability over time.

Statistically significant improvements across all OHIP-14 domains over time were demonstrated ($p < 0.001$), indicating consistent within-sample improvement in patient-reported outcomes.

While statistically significant changes were observed, the clinical significance of these findings should be interpreted with caution given the exploratory design, small sample size, and short follow-up duration.

Safety and Complications

Intraoperative and postoperative adverse events were prospectively documented. Implant trajectory was confirmed on immediate postoperative NCCT to remain within planned cortical boundaries without violation of adjacent anatomical structures. No major complications, including frontal sinus breach, cerebrospinal fluid leakage, orbital injury, neurovascular compromise, implant mobility, or early implant loss, were observed. Mild localized intraoral ecchymosis occurred in a small number of patients and resolved spontaneously without intervention.

Discussion

Corticobasal® implants engage stable cortical regions and allow anchorage beyond the atrophic alveolus [8, 16, 17].

The biomechanical principle of tripodization-using anterior and posterior cortical anchorage points is proposed

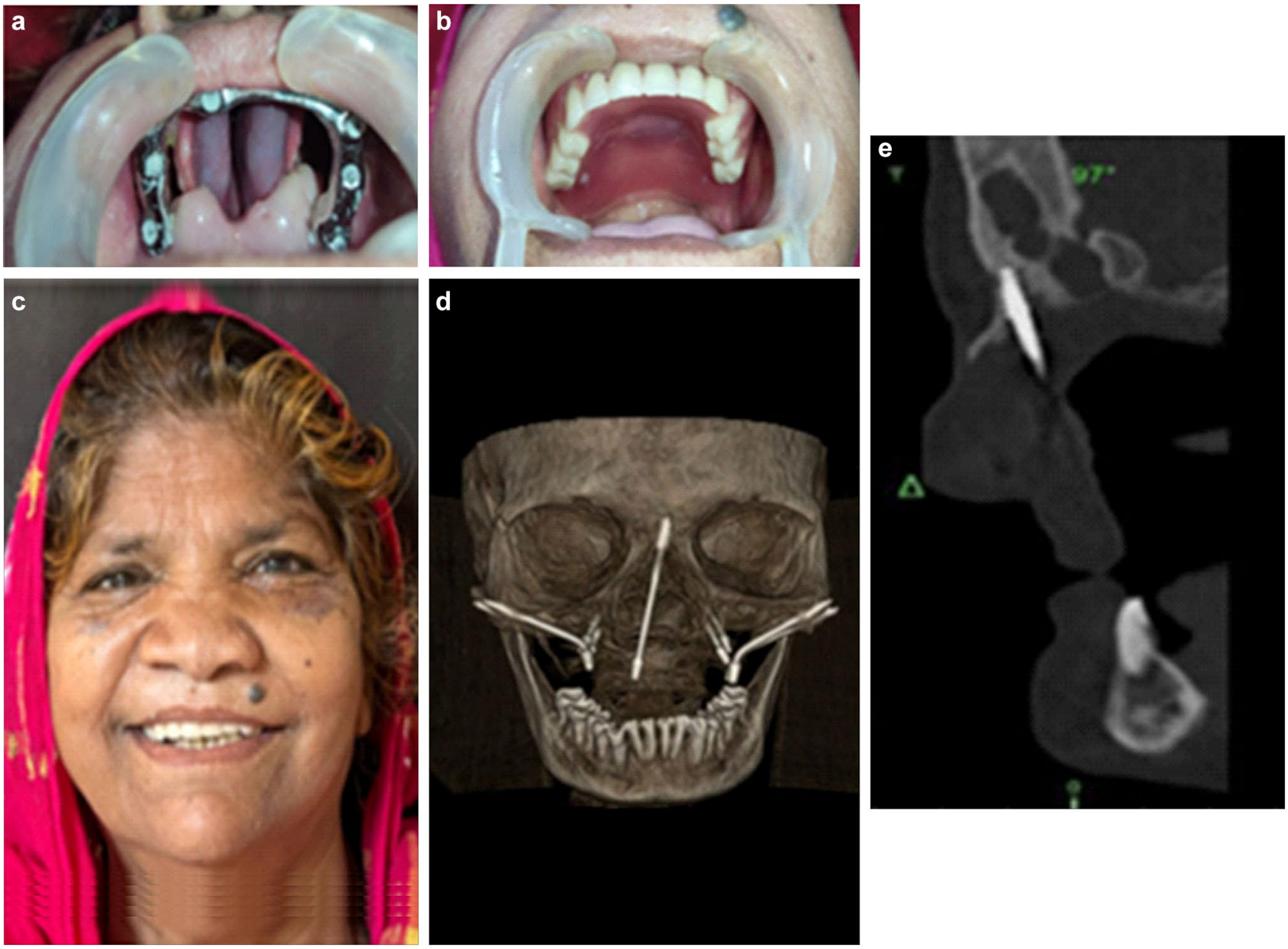

Fig. 3 Post operative pictures. **a** intraoral picture post implant & bar placement, **b** intraoral picture after final prosthesis insertion, **c** frontal view, **d** NCCT 3D image showing glabellar, zygomatic & the pterygoid implants, **e** NCCT image sagittal view of glabellar region showing the position of the implant

Table 1 Pain, periotest, and RFA values at different time points

Parameter	Time point	Mean ± SD	Statistical summary
VAS	24 h	4.60 ± 2.32	
VAS	1 week	3.33 ± 1.99	
VAS	4 weeks	1.40 ± 1.40	
VAS	12 weeks	0.60 ± 0.91	RM-ANOVA, $p < 0.001$
Periotest	1 week	− 1.33 ± 1.88	
Periotest	4 weeks	1.27 ± 2.19	Mean change: 2.60 (95% CI: 1.56–3.64)
Periotest	12 weeks	− 3.87 ± 2.36	Mean change: 2.53 (95% CI − 3.57 to − 1.49)
RFA	Immediate post-placement	62.93 ± 4.23	
RFA	12 weeks	69.53 ± 0.64	Mean change: 6.60 (95% CI: 4.38–8.82); paired t-test, $p < 0.001$

Table 2 Quality of life: functional and physical domains

Domain	PreOp Mean ± SD	4 weeks Mean ± SD	12 weeks Mean ± SD
Functional limitation	2.80 ± 0.77	0.80 ± 0.68	0.40 ± 0.51
Physical pain	3.80 ± 0.41	0.87 ± 0.64	0.20 ± 0.41
Physical disability	3.73 ± 0.46	1.40 ± 0.63	0.47 ± 0.52

Table 3 Quality of life: psychological and social domains

Domain	PreOp Mean ± SD	4 weeks Mean ± SD	12 weeks Mean ± SD
Psychological discomfort	3.07 ± 0.80	0.67 ± 0.49	0.13 ± 0.35
Psychological disability	2.80 ± 0.68	1.33 ± 0.62	0.27 ± 0.46
Social disability	1.33 ± 0.72	0.33 ± 0.49	0.00 ± 0.00
Handicap	2.20 ± 0.77	0.47 ± 0.52	0.00 ± 0.00

to improve load distribution and reduce cantilever forces. Alternative rehabilitation strategies for extensive maxillary defects include conventional obturator prostheses, free flap or graft reconstruction, and zygomatic implant-supported prostheses. Obturators may restore speech and swallowing but often require frequent adjustments and may provide compromised retention in extensive defects. Surgical reconstruction with flaps or grafts restores tissue continuity, but functional rehabilitation may remain limited and treatment morbidity is higher. Zygomatic implants provide reliable posterior cortical anchorage; however, in cases with extensive premaxillary and palatal bone loss, absence of anterior support may create long-arm flexion and cantilever-related biomechanical stress [6, 11, 12]. In such situations, when anterior cortical anchorage through the nasomaxillary buttress or nasoalveolarpalatine (nasalis) region is unavailable, a glabellar implant may serve as an alternative anterior cortical anchorage point providing a multi-vector stabilization framework [7, 11–13].

In the present study, repeated measures analysis demonstrated significant time-related reductions in pain ($p < 0.001$). This decline over 12 weeks corresponds with expected postoperative inflammatory resolution and tissue adaptation.

Implant stability parameters also showed significant changes over time. The transient increase in Periotest values followed by improved stability at 12 weeks reflects the transition from primary mechanical fixation to secondary biological stability through osseointegration. The increase in resonance frequency values is consistent with a trend toward increased stability over time [18, 19, 20].

All OHIP-14 domains demonstrated statistically significant improvements across all domains over time ($p < 0.001$). Improvements in functional limitation and physical pain may be associated with enhanced prosthetic retention and closure of oro-nasal communication. Psychological and social improvements may be associated with restored facial contour, speech function, and elimination of removable obturator-related discomfort [21–23].

The observed improvements should be interpreted with caution. Given the small sample size and repeated-measures design, findings may reflect within-sample trends and potential measurement ceiling or floor effects rather than definitive estimates of treatment effect.

Improvement in quality-of-life outcomes can be attributed to the glabellar implant splinted along with zygomatic and pterygoid implants, as rehabilitation involved a tripodized framework incorporating additional cortical anchorage sites and thus successfully distributing the masticatory forces along with buttresses resisting the long arm flexion. The absence of a comparison group and limited follow-up require cautious interpretation. Long-term data are needed to evaluate implant survival and prosthetic durability.

Anatomical Risk and Learning Curve

The glabellar region represents an anatomically constrained zone bordered by the frontal sinus superiorly, the cribriform plate 10 mm posterior to the frontal beak, and the orbit laterally. Although no major complications were observed in the present series, deviation from the planned trajectory may theoretically risk sinus violation, intracranial penetration, or orbital injury. In addition, the glabellar area contributes to midfacial contour, and inaccurate positioning could potentially influence aesthetic appearance. Careful preoperative imaging and trajectory planning are therefore essential.

Placement of implants in this region involves a technical learning curve due to limited anatomical safety margins and the requirements for precise three dimensional angulation. Outcomes are therefore surgeon-dependent and may vary with operator experience, familiarity with craniofacial anatomy, and proficiency in corticobasal implant biomechanics. These considerations are important when interpreting the present findings and when generalizing results to other clinical settings.

Limitations

This pilot study lacked a comparison group and involved a small sample. Statistical generalizability and follow-up is limited. Long-term implant survival, prosthetic durability, and complication rates were not assessed. Technical sensitivity and surgeon dependence may influence reproducibility across different clinical settings.

Conclusion

Within the limitations of a short-term single-arm exploratory design, rehabilitation incorporating a glabellar implant was feasible and showed favorable short-term clinical and patient-reported outcome trends. The observed improvement in quality of life may be associated with the incorporation of a glabellar implant as part of a tripodized framework with zygomatic and pterygoid implants in cases with absent premaxilla and palatal bone, where successful functional rehabilitation was achieved under an immediate functional loading protocol. The addition of an anterior implant in the glabellar region may help reduce the functional impact of cantilever forces by increasing the anterior–posterior spread of support, which is an important determinant of stress distribution in implant-supported prostheses. However, causal inferences regarding the specific contribution of the glabellar implant cannot be made. Larger controlled studies with long-term follow-up are required to evaluate comparative effectiveness and durability.

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Author Contributions Tanvi Vinarkar- Concept, data acquisition, manuscript drafting. U. S. Pal- Study design, critical revision. Vivek Gaur- Technique refinement, surgical procedure explanation. Vibha Singh- Surgical supervision. Vijay Kumar- Manuscript review. Lakshya Kumar- Data refinement.

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Data Availability Data available on request from corresponding author.

Code Availability Not applicable.

Material Availability Not applicable.

Declarations

Conflict of Interest The authors declare no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Institutional Ethics Committee of the King George's Medical University (Reference Code: XXV PGTSC IIA/P10).

Consent to Participate Written informed consent was obtained from all participants.

Consent for Publication All patients provided written informed consent for publication of clinical details & images.

Trial Registration This study was observational and not a registered clinical trial.

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