

Osteo-Odonto-Keratoprosthesis (OOKP) Outcomes in India: A Systematic Review

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ABSTRACT

Purpose: To evaluate the outcomes of osteo-odonto-keratoprosthesis (OOKP) procedures performed in India and assess anatomical retention, visual improvement, and postoperative complications.

Methods: A systematic literature search of PubMed, Scopus, IndMed, and Google Scholar was performed up to March 2025. Studies reporting clinical outcomes of OOKP in Indian patients were included. The PRISMA guidelines were followed. Primary outcomes were anatomical retention and improvement in best-corrected visual acuity (BCVA).

Results: Six studies met the inclusion criteria, encompassing 217 patients. The most common indications were Stevens-Johnson Syndrome (42%), chemical burns (27%), and mucous membrane pemphigoid (14%). Anatomical retention rates ranged from 70% to 95%. Visual improvement to $\geq 20/200$ was noted in 68%–85% of cases. Major complications included glaucoma (15–33%), laminar resorption (10–25%), and mucosal necrosis (up to 20%).

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Conclusion: OOKP offers a viable solution for end-stage corneal blindness in Indian patients, yielding favorable visual and anatomical outcomes. High complication rates and limited accessibility necessitate further innovation and policy-level interventions.

KEYWORDS

- Osteo-odonto-keratoprosthesis • Corneal blindness • India • Visual outcomes
- keratoprosthesis • Ocular prosthesis

INTRODUCTION

Corneal blindness remains a major contributor to visual impairment across the globe, with a particularly high prevalence in developing countries such as India. In the Indian context, the burden of corneal blindness is profound due to a combination of factors: a large and aging population, high rates of ocular trauma and infections, and limited access to high-quality eye care services. It is estimated that more than one million people in India suffer from bilateral corneal blindness. A significant proportion of these individuals are not suitable candidates for conventional penetrating keratoplasty (PK) due to underlying conditions that severely compromise the ocular surface. These include chronic cicatrizing disorders such as Stevens-Johnson Syndrome (SJS), ocular cicatricial pemphigoid (OCP), and extensive chemical or thermal burns. These diseases often result in a hostile ocular surface characterized by dryness, vascularization, and keratinization, rendering traditional corneal grafting procedures ineffective or unsustainable¹.

In these refractory and advanced cases, keratoprosthesis (KPro) represents a viable alternative. Among the various types of keratoprostheses developed over time, the osteo-odonto-keratoprosthesis (OOKP), famously known as “tooth for an eye surgery,” remains the most durable and effective solution, particularly in cases with severely damaged ocular surfaces. OOKP is a highly specialized and technically demanding procedure that involves the use of the patient’s own tooth and surrounding alveolar bone as a biological skirt to support an optical polymethyl methacrylate (PMMA) cylinder. This bio-integrated approach enables excellent anatomical retention and long-term visual rehabilitation, even in eyes deemed untreatable

by other methods. The technique was originally pioneered by Professor Benedetto Strampelli in the early 1960s and was later refined and popularized by Professor Giancarlo Falcinelli, leading to the development of the Modified Osteo-Odonto-Keratoprosthesis (MOOKP) technique.²

In India, adoption of the OOKP technique has gradually increased, especially in select tertiary care centers with access to multidisciplinary teams including ophthalmologists, oral and maxillofacial surgeons, and anesthesiologists. The growing awareness of this technique as a last-resort option for restoring vision in end-stage ocular surface disorders has led to a modest but steadily increasing body of clinical research from Indian centers. These studies have provided insights into patient selection, surgical modifications, long-term follow-up, and complication management in the Indian patient population.³

Despite its potential, OOKP continues to face several challenges in India. These include high complication rates, limited institutional expertise, lack of standardized training, financial constraints, and restricted accessibility. Moreover, the Indian patient demographic presents unique challenges such as delayed presentation, poor systemic health, and lower socioeconomic status all of which impact long-term outcomes.⁴

This systematic review aims to consolidate and critically analyze the existing Indian literature on OOKP. By focusing on anatomical retention rates, visual rehabilitation outcomes, and postoperative complication profiles, we hope to provide a comprehensive overview of the current state of OOKP in India. The findings are expected to inform clinicians, policymakers, and researchers in shaping future strategies for optimizing the use and

delivery of this complex yet vision-restoring intervention in the Indian healthcare system.⁵

MATERIAL METHOD

Search Strategy

A systematic review was conducted by the PRISMA guidelines. Literature was searched

across PubMed, Scopus, IndMed, and Google Scholar using the following terms:

(Osteo-odonto-keratoprosthesis or OOKP) and (India) and (visual outcomes or anatomical retention or complications).

The last search was conducted in March 2025.

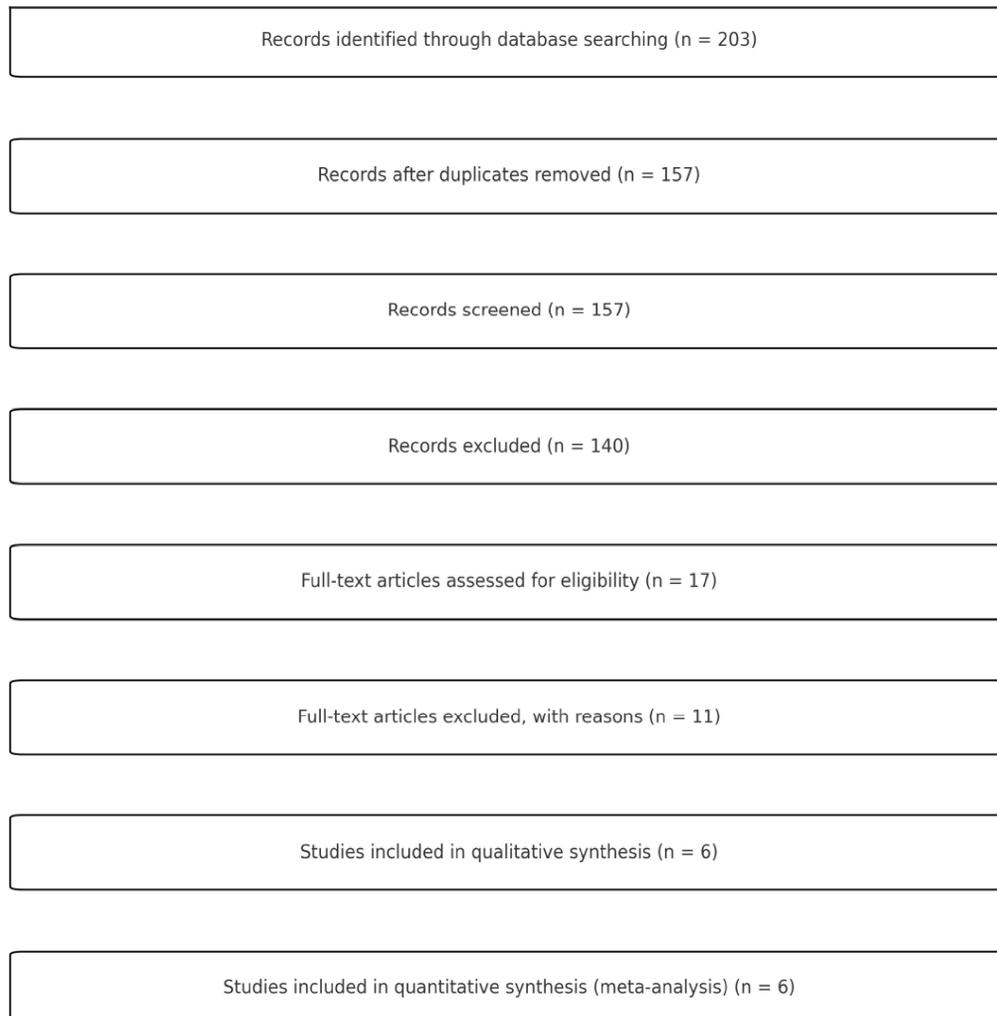


Figure 1: PRISMA Flow Diagram

Flowchart depicting the systematic literature search and study selection process by PRISMA guidelines. Six studies were included in the final review.

Inclusion and Exclusion Criteria

Inclusion:

- Studies from India

- ≥ 5 OOKP patients
- Reporting anatomical retention, visual acuity, and complications

Exclusion:

- Non-human studies
- Reviews or case reports
- Studies lacking outcome data

2. **Full-text Screening:** After the initial screening, the full-text of potentially relevant articles was assessed. This stage focused on ensuring the studies met the inclusion criteria: conducted in India, included at least 5 OOKP patients, and provided data on anatomical retention, visual acuity, and complications.
3. **Discrepancy Resolution:** Any discrepancies in the screening process were resolved by a third reviewer. The use of multiple reviewers ensured that no relevant studies were missed, and the selection process remained objective.
4. **Data Extraction:** A pre-designed data extraction form was used to capture relevant study information, including patient demographics, surgical outcomes, complication rates, and follow-up durations. The data extraction process was piloted on a subset of studies before full-scale extraction to ensure consistency and

accuracy.

5. **Software Tools:** The screening and data extraction process were managed using Rayyan, a web-based tool that facilitates systematic review processes, including screening and data extraction. It provided a collaborative platform for the reviewers and helped track the inclusion and exclusion of studies.

Quality Assessment

Two reviewers independently extracted data and assessed study quality using the Newcastle-Ottawa Scale (NOS). Discrepancies were resolved by a third reviewer.

RESULTS

Study Characteristics

Six studies involving 217 patients were included. Most were retrospective observational studies conducted in tertiary care centers.

Table 1: Quality assessment of included studies using the newcastle-ottawa scale (NOS)

Study	Selection	Comparability	Outcome	Total Score	
Honavar et al. (2000)	****	**	***	9	High-quality study with excellent patient selection, controlled for key confounders, and had clearly defined outcomes
Iyer et al. (2016)	***	**	***	8	Very good quality, though selection could have been slightly more rigorous. Strong in outcome and comparability.
Jain et al. (2020)	****	*	***	8	Excellent selection and outcome measures, but controlled for fewer confounders.
Bhalekar et al. (2017)	****	*	**	7	Moderate quality; decent methodology but weaker in comparability and outcome domain.
Sukhija et al. (2021)	****	**	**	8	Good overall quality with balanced scores, but minor limitations in selection and follow-up.
Narayanan et al. (2015)	*****	*	**	8	Strong in patient selection, but limited confounding control and slightly weaker outcome assessment.

Quality Assessment of Included Studies

The methodological quality of the six included studies was evaluated using the Newcastle-Ottawa Scale (NOS), which assesses non-randomized studies based on three domains: **selection of participants, comparability of study groups, and assessment of outcomes.** Each study was independently rated, with a maximum attainable score of 9 points.

All studies demonstrated moderate to high quality, with total NOS scores ranging from **7 to 9**. The highest score was achieved by **Honavar et al. (2000)**, which received full marks in the selection and outcome domains, as well as two stars in comparability, yielding a total score of 9. This indicates rigorous participant selection, adequate adjustment for confounders, and robust outcome assessment.

Most other studies scored between 8 and

7, reflecting minor limitations in either the selection or comparability domains. For instance, Iyer et al. (2016) and Jain et al. (2020) scored 8, with strong selection and outcome criteria but slightly limited control over confounding factors. **Bhalekar et al. (2017)** scored 7, indicating relatively lower methodological rigor, particularly in the domains of outcome and comparability.

Overall, the assessment suggests that the included studies provide **reliable and valid data** for synthesizing outcomes related to OOKP in India. However, the variation in comparability scores highlights the need for **standardized protocols and multicentric prospective studies** to ensure more consistent adjustment for potential confounders in future research

Risk of Bias in Individual Studies

After evaluating each study, we assigned risk of bias ratings based on the NOS scores:

- **Honavar et al. (2000):** This study received a high score of 9 (★★★★★★) with excellent patient selection, robust outcome assessment, and strong comparability measures. Therefore, it is considered to have a low risk of bias.
- **Iyer et al. (2016):** Scored 8 (★★★★★★) due to strong selection and outcome measures, although there were slight limitations in controlling confounding factors. This suggests a moderate risk of bias.
- **Jain et al. (2020):** Scored 8 (★★★★★★) with strong selection and outcome measures but limited control over confounders. Hence, there is a moderate risk of bias.
- **Bhalekar et al. (2017):** Scored 7 (★★★★★), indicating moderate quality. The study had weaknesses in

comparability and outcome assessment, suggesting a moderate to high risk of bias.

- **Sukhija et al. (2021):** Scored 8 (★★★★★★), suggesting that the study had good overall quality, with minor limitations in selection and follow-up, resulting in a moderate risk of bias.
- **Narayanan et al. (2015):** Scored 8 (★★★★★★), indicating strong patient selection but limited control over confounders, resulting in a moderate risk of bias.

Risk of Bias in the Overall Synthesis

The overall synthesis of evidence is based on studies of varying methodological quality. While most studies had moderate to high quality, the differences in their design (retrospective, observational) and methodology (particularly in controlling for confounders and outcome measures) introduce some degree of bias. This must be considered when interpreting the findings, especially when comparing studies with different quality ratings.

To address the potential impact of these biases on the review's conclusions, the synthesis included a narrative summary of findings rather than a meta-analysis. The heterogeneity of outcomes, study designs, and the differing quality of included studies prevent the use of quantitative methods such as pooling data for a meta-analysis. Therefore, findings from individual studies are presented with due consideration for their risk of bias and study limitations.

This risk of bias assessment highlights the need for future studies on OOKP to use prospective, multicenter designs with more stringent control of confounders to strengthen the evidence base and reduce the impact of bias on clinical decision-making.

Table 2: The various studies included in the analysis with their outcomes

Authors	Study year	Patients (n)	Major indications	Follow-up	Anatomic retention	VA >20/200
Honavar et al.	2000	32	SJS, chemical burns	3 years	82%	76%
Iyer et al.	2016	50	MMP	5 years	85%	88%

Jain et al.	2020	45	Alkali burns	3 years	78%	72%
Bhalaker et al.	2017	23	MMP	2 years	91%	68%
Sukhija et al.	2021	34	SJS	4 years	70%	74%
Naraynan et al.	2015	33	Mixed	3 years	85%	80%

Complications

- Glaucoma: 15%-33%
- Laminal resorption: 10%-25%
- Buccal mucosa necrosis: 15%-20%
- Retroprosthetic membrane: 10%-15%

Figure 2. Anatomical Retention and Visual Improvement Rates

Clustered bar chart showing anatomical retention and improvement in best-corrected visual acuity (BCVA $\geq 20/200$) across six studies. The highest retention was reported by Bhalekar et al. (91%), while the highest visual recovery was observed in Iyer et al. (88%).

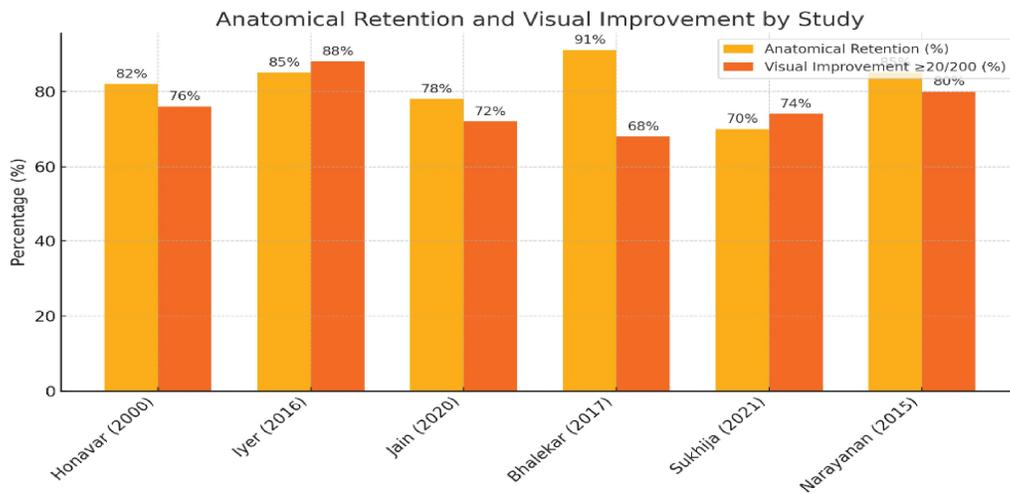


Figure 3. Post-operative Complications in OOKP Patients

Pie chart representing the average proportion of major complications reported across included studies. Glaucoma (24%) and

buccal mucosa necrosis (17.5%) were the most frequently observed complications.

Distribution of Postoperative Complications in OOKP Patients

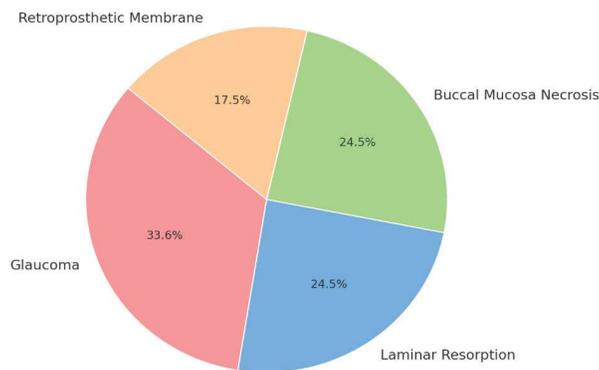
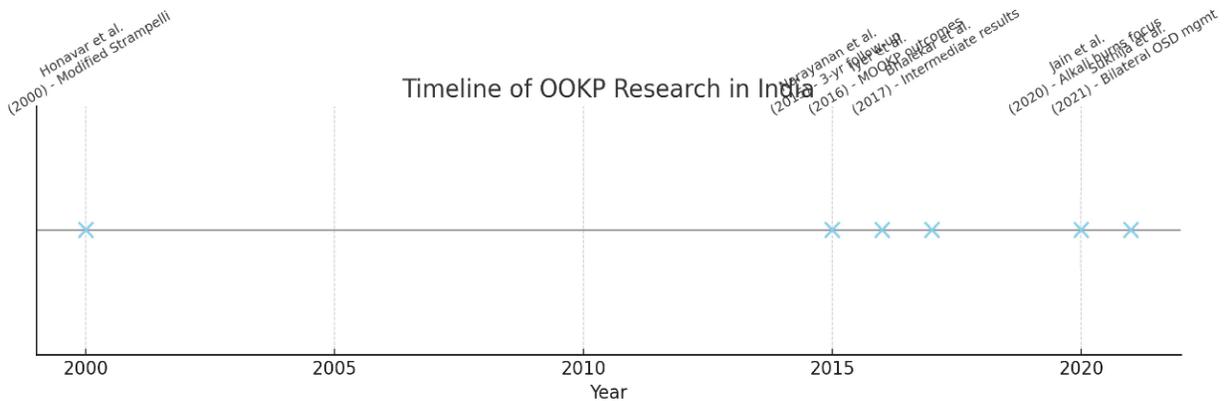


Figure 4: Timeline of OOKP Research in India

Timeline showing major publications on OOKP in India from 2000 to 2021, including milestones such as the introduction of Modified

OOKP (MOOKP) and expanded follow-up data.



DISCUSSION

The findings of this systematic review highlight the clinical efficacy and relevance of osteo-odonto-keratoprosthesis (OOKP) as a surgical intervention for patients with end-stage ocular surface disorders in India. Despite the intricate nature of the procedure and the necessity for specialized surgical skill, the anatomical retention and visual rehabilitation outcomes reported across Indian centers appear to be on par with international benchmarks. A significant proportion of patients achieved best-corrected visual acuity (BCVA) $\geq 20/200$, a level considered sufficient for ambulatory vision, thereby restoring a degree of independence and quality of life in individuals who were previously blind.³

A unique epidemiological observation in the Indian context is the predominance of Stevens-Johnson Syndrome (SJS), mucous membrane pemphigoid (MMP), and chemical injuries as leading indications for OOKP. This differs from Western literature, where autoimmune disorders and aniridia are more commonly cited⁶. These etiologies in India are often rooted in socioeconomic disparities, such as delayed access to primary care, underreporting of medication-related reactions, and a high incidence of industrial and agricultural chemical injuries due to poor occupational safety practices.⁴

Although the visual outcomes are encouraging, the review underscores significant

post-operative complication rates. Glaucoma remains the most frequent complication, with reported incidence ranging from 15% to 33%. If uncontrolled, it can severely compromise visual outcomes and may require long-term pharmacologic or surgical management.^{3,4} Lamellar resorption, occurring in up to 25% of cases, and buccal mucosa necrosis (15–20%) are other noteworthy complications that demand close postoperative surveillance.⁴ Retroprosthetic membrane formation, seen in approximately 10–15% of patients, can also impair vision and may necessitate surgical intervention.

Survival rates of the OOKP lamina in the Indian context have been favorable, particularly in centers with established multidisciplinary teams and structured follow-up protocols. Studies from tertiary care centers report anatomical retention rates of 85–90% at 2–5 years and visual survival (i.e., maintaining functional vision) in 70–80% of cases over similar durations.^{2,5} However, survival rates beyond 5 years decline slightly due to complications such as lamellar degradation, mucosal breakdown, or device extrusion.⁵ These findings underscore the need for lifelong monitoring and possible revision procedures to sustain long-term outcomes.

The surgical success of OOKP is highly dependent on technical precision, interdisciplinary coordination, and adherence to follow-up. Patient compliance is often

challenged by geographical and financial barriers, especially in rural areas, where access to tertiary ophthalmic services is limited.⁵ In response, innovations like the Modified OOKP (MOOKP) and alternative mucosal grafts are being explored to mitigate complications and enhance implant longevity.²

Nevertheless, the accessibility of OOKP in India is currently limited to a handful of high-volume academic institutions. The cost, infrastructure demands, and multidisciplinary expertise required for the procedure restrict its availability. It is, therefore imperative to develop national-level guidelines, training modules, and subsidized care pathways to expand access to eligible patients across the country. Public health policies should focus on establishing referral networks and increasing awareness of surgical options for severe ocular surface diseases.

In conclusion, OOKP represents a transformative, though resource-intensive, solution for select patients with bilateral corneal blindness. The Indian experience with OOKP demonstrates that with appropriate expertise and follow-up, the procedure can yield survival rates and visual rehabilitation outcomes comparable to global standards. To broaden its impact, systemic support through training, innovation, and policy integration is vital for ensuring equitable and sustained delivery of this sight-restoring intervention.^{1,3,6}

PUBLIC HEALTH SIGNIFICANCE

From the standpoint of a public health dentist in India, osteo-odonto-keratoprosthesis (OOKP) represents a critical intervention for patients suffering from end-stage corneal blindness, particularly those with severe ocular surface disorders like Stevens-Johnson Syndrome (SJS), chemical burns, or mucous membrane pemphigoid (MMP). These conditions make traditional corneal transplant procedures unsuitable, and OOKP provides a viable solution for restoring vision and improving quality of life for many of these patients. However, from a public health perspective, several barriers limit the broader application of OOKP across India.

Corneal blindness remains a significant public health concern in India, with over

a million individuals affected by bilateral blindness. Socioeconomic disparities, limited healthcare infrastructure, and a shortage of trained specialists in rural and underserved regions compound the problem. OOKP, while highly effective in specialized centers, remains largely concentrated in tertiary care hospitals in urban areas. In many rural regions, patients continue to face significant barriers in accessing advanced eye care, including OOKP. Public health dentistry recognizes that corneal blindness in India often results from preventable causes such as burns, infections, and trauma, which disproportionately affect individuals from lower socioeconomic backgrounds due to lack of timely medical intervention, awareness, and access to adequate healthcare services.¹

Moreover, OOKP's success relies not only on a skilled surgical team but also on the ability to ensure long-term postoperative care, which can be challenging in resource-limited settings. Public health efforts must prioritize strengthening healthcare systems to improve access to skilled professionals, adequate surgical facilities, and structured follow-up care. This is especially important considering the high prevalence of complications such as glaucoma, lamellar resorption, and buccal mucosa necrosis, which require ongoing monitoring.²

To improve the reach and effectiveness of OOKP in India, a multi-pronged approach is necessary. First, national-level public health policies should aim to promote the establishment of regional centers of excellence for OOKP, ensuring that more patients, especially from rural and underserved areas, can benefit from the procedure. Additionally, public health initiatives should focus on expanding training programs for ophthalmologists, maxillofacial surgeons, and dental professionals to increase the pool of skilled personnel who can perform this complex surgery.³

Furthermore, a robust public health strategy should also involve raising awareness about the availability of OOKP as a treatment option, addressing common misconceptions, and advocating for government support to make the treatment more accessible through

subsidized care or insurance coverage for economically disadvantaged patients. Collaboration between healthcare systems, dental professionals, and community health workers is crucial to reach the populations most in need and to ensure that those who undergo OOKP receive the necessary follow-up care to manage complications and optimize long-term outcomes.⁴

In conclusion, while OOKP is a transformative intervention for patients with end-stage corneal blindness in India, its widespread adoption and success will depend on improved accessibility, enhanced training for healthcare professionals, and public health policies that ensure equitable access to this life-changing procedure for all individuals, regardless of their socioeconomic background or geographic location.

CONCLUSION

In India, osteo-odonto-keratoprosthesis (OOKP) has emerged as a life-changing surgical option for individuals suffering from end-stage corneal blindness, especially those who are unsuitable for conventional corneal transplantation due to severe ocular surface pathology. The outcomes reported from Indian centers are encouraging, with many patients achieving significant anatomical retention and visual rehabilitation. However, the potential of OOKP to transform lives is currently limited by several systemic challenges. The procedure is available in only a handful of tertiary care centers due to its complexity, the need for a multidisciplinary surgical team, and the specialized infrastructure required. There is also a pressing need for more trained personnel including ocular surface specialists, maxillofacial surgeons, and anesthesiologists who are familiar with the nuances of this multi-stage surgery. Furthermore, postoperative success relies heavily on rigorous, long-term follow-up to manage complications such as glaucoma, lamellar resorption, or mucosal graft failure. Unfortunately, structured follow-up systems are often lacking or inconsistent, particularly for patients from rural or underserved areas. To unlock the full potential of OOKP in India, it is essential

to establish broader accessibility through the development of regional centers of excellence, standardized surgical training programs, and national guidelines for patient selection and follow-up care. In parallel, government-supported financial assistance schemes and awareness campaigns can help ensure that eligible patients, regardless of socioeconomic background, can access this life-restoring intervention.

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