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Determining The Position Of Iris In An Ocular Prosthesis : A Systematic Review

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Abstract
Aim: *To compare various approaches, strategies, and ideas reported in the literature in order to precisely measure iris location in relation to the relevant dimensions in order to carry out maxillofacial rehabilitation with an ocular prosthesis.*
Settings and Design: *The most popular reporting methodology, PRISMA standards, were followed in the conduct of this systematic review.*
Materials and Methods: *We searched PubMed and Cochrane Library, two electronic databases, for publications published between 1969 and September 30, 2019. A peer-reviewed electronic search limited to dental literature written in the English language was carried out to find pertinent scientific articles about the placement of the iris in maxillofacial prosthesis. After reading the abstracts separately, two observers chose 17 full-text publications that met the requirements for inclusion.*
Statistical Analysis Used: *Nometa-analysis was conducted due to heterogeneity of data obtained.*
Results: *The 17 published articles that describe how to determine the iris positioning for maxillofacial prosthetic rehabilitation using a transparent graph grid, an ocular locator with a fixed caliper, a window light, a plastic template strip, a Boley's gauge, a millimeter ruler, a pupillometer, and inverted anatomic tracings were all methodically reviewed.*
Conclusion: *As of right now, the optimal method for precisely matching the iris placement has not been the subject of a thorough study of the literature. The most recent methods, which include digital technology in the form of digital imaging, are thought to be more accurate in terms of iris location within the ocular prosthesis.*
Keywords: *Customized scale, facial measurements, graph grid, iris positioning, ocular prosthesis.*

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I. Introduction

As they say, eyes are the "mirror of the soul." They serve being the focal point of facial emotions, and the pinnacle of human beauty. Anophthalmia may result from congenital abnormalities, sympathetic ophthalmic disease, cancer, or trauma. Following these clinical scenarios, surgical intervention may suggest orbital evisceration, enucleation, or exenteration. Such disfigurements may have a profound psychological impact on sometimes leading to a traumatic emotional fallout. For these people, an ocular prosthesis serves as a prosthodontic rehabilitation tool to replace their missing or malformed eye globe.

The major challenge faced by the prosthodontist is of cicatricial retraction, during the fabrication of an ocular prosthesis in the anophthalmia sockets. This happens so because in such situations there is atrophy leading to the modifications in the form of a reduction in the dimensions of the prosthesis to have a perfect contour so that artificial iris will provide realistic, symmetrical, and a natural appearing gaze.

This problem is more typical when the defect areas are the eyes and the orbital contents, resulting in the gross mutilation of the face. For these types of patients, the basic need in the early and satisfactory rehabilitation of the lost tissues to their normal anatomic form for the overall enhancement of Health related Quality of Life. The surgical reconstruction alone cannot be an alternative towards the satisfactory esthetic rehabilitation of the orbital defects with a total loss of eyelids and the eyeball. Many defects of such types also require some kind of prosthetic rehabilitation. The key to a successful rehabilitation in such cases is the careful preoperative surgical as well as prosthetic planning using a multidisciplinary approach.

They can be used for a provisional or an immediate postoperative period. Ocular prostheses can be referred to variously as artificial eyes, molded eyes, cosmetic contact shells, cosmetic contact lenses, or spectacle prostheses. Various methods and techniques are documented in the literature to determine the iris positioning to perform maxillofacial prosthetic rehabilitation for example, the use of a plastic strip template, a Boley's gauge, a millimeter ruler, a pupillometer, window light or light reflection viewed symmetrically in the eyes, an ocular locator with fixed caliper, inverted anatomic tracings, a transparent graph grid, computer simulation approach with optical scanning technique, and computer aided design and a customized scale for assessing the position of the ocular prosthesis.

However, so far, no systematic reviews on various methods of iris positioning in maxillofacial prostheses have been reported. Hence, the purpose of this document is to review the available literature about iris positioning in maxillofacial prosthetics. The question that this review proposes to answer is to compare and evaluate various methods, techniques, and concepts documented in the literature to position the iris accurately to the related dimensions required to perform maxillofacial rehabilitation of ocular prosthesis.

II. Materials And Methods

This systematic review was conducted following the PRISMA guidlines. The PICO format was applied to formulate a focus question and accordingly a systematic search strategy was outlined for the study.

Review Question

The following PICO question was used to frame the search strategy:

Population- Patients with anophthalmic defects requiring an ocular prosthesis.

Intervention- Patients rehabilitated with ocular prosthesis using various methods for iris positioning.

Comparison- Various techniques for rehabilitation of an ocular prosthesis including all the conventional and digital methods of iris positioning.

Outcome

Primary outcome- Accuracy of the iris positioning of the ocular prosthesis as defined by the authors Secondary Outcome-

1. Patients perception regarding the esthetic outcome of the ocular prosthesis.
2. Feasibility of Maxillofacial Prosthodontist about the ease of fabrication and precision of iris positioning.

III. Literature Search

The final search was conducted manually from the selected articles for the cross-references and citations, to include all relevant articles and to improve the electronic search. Two reviewers were appointed to screen the titles and abstracts independently. Full texts of articles that fulfilled the inclusion criteria were obtained. Two electronic databases (PubMed and Cochrane Library) were searched for manuscripts published from 1969 until September 30, 2019.After the electronic and manual search, PubMed gave, 122 articles but Cochrane Library indicated no systematic review published on this topic so far. The total number of articles that were presented for the search.

Table1: Studies regarding Iris positioning in ocular prosthesis

Study	Year	Technique(instrument)
Roberts*etal*.	1969	Pupillometer
Brown*etal*.	1970	Facialmeasurementsusinganato mic landmarks
JonejaOP*et al*.	1976	Windowlight
HeleneJames*etal*.	1976	VisualAssessment
McArthur*etal*.	1977	Ocularlocator
Nusinov*etal*.	1988	Invertedanatomictracings
Guttal*etal*.	2007	Graphgridmethod
ManviS*etal*.	2008	Boleysgauge
Pai*etal*.	2010	Gridcutoutsplacedonspectaclefr ame
Gupta*et al*	2013	Customizedscale
YunpenBi*etal*.	2013	CAD/CAM
ShettyPP*etal*.	2017	ModifiedHanauwide-viewspringb ow
Chamaria*etal*.	2017	Customizedframespringbowasse mbly
Bhochhibhoya*et al*.	2019	Pupillarydistanceruler.
Dasgupta*etal*.	2019	Digitalphotograph
Chihargo*etal*.	2019	OpticalvernierIPDruler
Lanzara*etal*.	2019	Electronicverniercaliper

IV. Results

Results of data extraction

After obtaining the full text of these 21 publications, 4 of them were deleted due to duplication (identical procedures with slight modifications) following a comprehensive examination by each of the reviewers for these 21 articles separately. As a result, 17 publications made up the final sample size for this systematic review.

Results of included studies

This systematic review included the following methods and techniques for iris positioning in ocular prosthesis: pupillometer by Roberts; facial measurements using anatomic landmarks by Brown; window light by Joneja et al.; visual assessment by Helene James et al.; ocular locator by McArthur; inverted anatomic tracings by Nusinov et al.; graph grid method by Guttal et al.; Boleys gauge by Manvi et al.; grid cutouts placed on spectacle frame by Pai et al.; use of CAD/CAM by Bi et al.; modified Hanau wide-view spring bow by Shetty et al.; customized frame spring bow assembly by Chamaria et al.; pupillary distance (PD) ruler by Bhochhibhoya et al.; digital photograph by Dasgupta et al.

V. Discussion

For a prosthodontist, treating patients with an eye deficiency is a difficult undertaking. The exact placement of the iris in an ocular prosthesis is essential for achieving aesthetics. Humans have known how to make artificial eyes since the prehistoric era. The literature has a number of case studies about the placement of the iris in prosthetic eyes. However, no comprehensive review has been done on this subject up until this point. The current systematic review focuses on several methods and specially designed toolsfor precisely placing the iris in a prosthetic eye. Thissystematic review covered articles from 1969 to October 2019 that met the study's inclusion criteria. Roberts created an equipment in 1969 called a pupillometer for iris projection in prosthetic eyes.

The window light was utilized by Joneja et al. to modify the iris. James and colleagues used transparent acrylic to paint the iris and "lense" it in the cornea. He put the iris and cornea together, placed it in a wax pattern, and made adjustments until the aesthetic was good. These subjective ways of iris positioning, including face measurements, visual perceptions, and window light measures, may have biased the operator's ability to position the iris properly. Thus, a movement toward more objective techniques emerged. McArthur centered the iris using the ocular locator. He positioned an Ocular locator on the face of the patient so that the marked midline and horizontal lines are superimposed over the markings made on the patient’s face to trace the anatomy of the eye.

An approach to forecast the iris location using inverted anatomic tracings was described by Nusinov et al. The orbital anatomy was traced and transferred on the acetate sheet, and lines were drawn on the face. After that, the iris was orientated and it was inverted over the defect. Boley's gauge was utilized by Supriya et al. to precisely position the iris in a prosthetic eye. To precisely position the iris, Guttal et al. used a grid template [Figure 6].

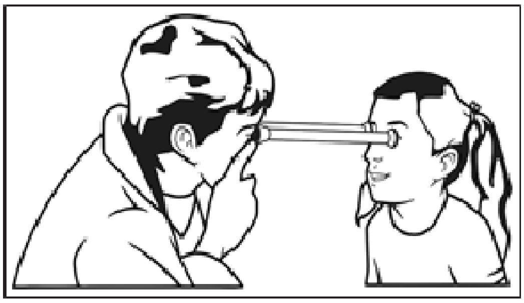
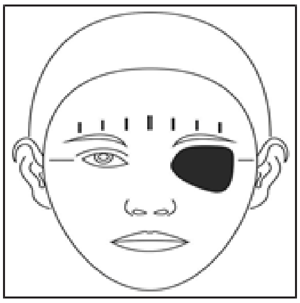
Compared to ocular evaluation, the use of a transparent graph grid provides a straightforward and trustworthy technique for iris location. However, this approach is prone to interobserver error and needs a helper to retain the graph. In 2010, Pai et al. utilized glasses that had a graph grid affixed to the glass lens. He described the typical eye and connected it to anatomical structural markers. Iris alignment was completed and the graphic cutout of the healthy eye was rotated over the defective eye's eyeglasses lens to create a mirror image. To help orient the iris in a prosthetic eye, Dasgupta et al. also created glasses with clear, gridded acrylic, akin to Kestenbaum glasses. Using gridded glasses in this way is easy, needs minimal equipment, and cuts down on chairside time. In addition, mounting the graph grid on eyeglasses is more stable and requires less help than holding the graph grid in front of the face in one's hands. In order to place the iris, Chamaria et al. created a personalized acrylic resin frame with a graph grid assembly that was fastened to a face bow [Figure 8].

In order to measure the location of the iris on the normal eye that was passed on the scleral wax up of the defect side eye, a scale was attached to the face bow with the aid of ballpoint pen caps.[26] By flipping the spring bow's U-shaped metal frame, Shetty et al. were able to position the iris by securing the orbital pointer at the bottom edge of the left ala of the nose, which also served as the third reference point [Figure 9]. An iris measuring and orienting tool comprised a transfer clamp assembly, two paper clips, and a graduated scale fastened to a face bow fork.

For iris placement, Gupta et al. employed a bespoke scale [Figure 10]. This scale, which served to align the iris in all three plans—mediolaterally, superio inferiorly, and anteroposteriorly—had marks from zero to four on top and vice versa at the bottom. This method's ability to orient iris without using a shared reference plane allowed the scale to be effectively applied to patients with facial asymmetry. But building such a personalized scale is time-consuming and prone to manufacturing mistakes. Objectively prepared scales were explored in order to get around these issues and eliminate the observer bias that exists with traditional methods. In order to orient the iris in an eye prosthesis, Bhochhibhoya et al. in 2019 employed a PD ruler [Figure 11]. The patient's nose was used as the axis on the PD scale, a graded horizontal scale, to measure the iris's mediolateral proportions and papillary distances in a normal eye. These measurements were then translated to the defect region to determine where the iris should be placed in a prosthetic eye.

This method turned out to be affordable and low-skilled. This method was ineffective in situations of face asymmetry because it concurrently assesses the locations of both irises using a shared reference plane. In 2019, Chihargo and Syafrinani [30] [Figure 12] oriented the iris in symmetry with the neighboring normal eye using an IPD ruler. In order to do iris placement, Lanzara et al. marked the patient's face with references, then recorded those references using an electronic vernier caliper [Figure 13]. It was shown that objective measurement was superior thansubjective measurement when evaluating iris position. Utilizing appliances or instruments featuring millimeter scales allows for precise measurements while centering an iris. In addition, they are inexpensive, user-friendly, pleasant for patients, and suggested for clinical use in compact spaces. In order to create a 3D facial model, Bi et al. recorded patients' faces using a 3D scanning (CAD CAM) technology.

To place the iris, the measured values were reflected onto the defect region and recorded. This method's benefit is that clinical appointments take less time, and manufacture is simple and rapid. Digital photography was utilized by Dasgupta et al. to locate the iris. He used a digital single lens reflex camera to take a clear portrait of his face [Figure 14]. A series of clicks were made such that the flashlight reflected in the middle of the normal eye's pupil on the picture, and various measurements were then noted to precisely locate the iris on the image. Since the face measurements and positioning were done on the image, these digital procedures did not require a complicated armament or the participation of the patient. To obtain the desired aesthetics in an ocular prosthesis, specialists must acquire the necessary knowledge and abilities for utilizing this software.

F**igure2:** Pupillometer
Figure3: Facial measurement susing Anatomic landmarks

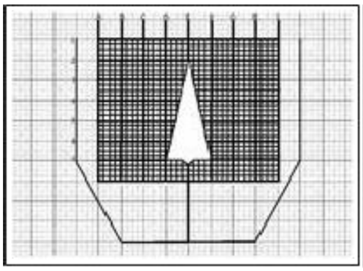
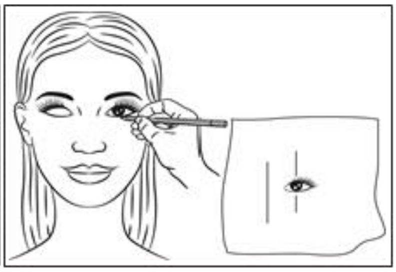



Figure4: Ocular locator
Figure5: Inverted anatomic tracing

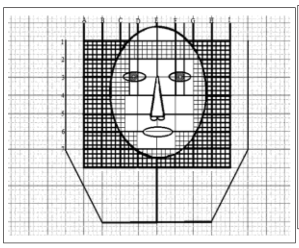
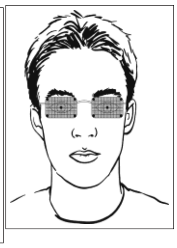



Figure6: Photo grid technique
Figure7:Grid customs placed on spctacles

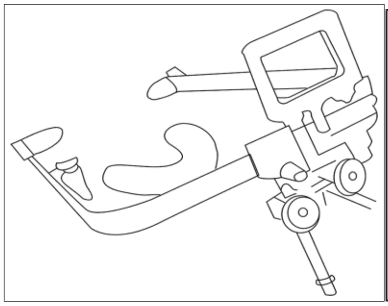
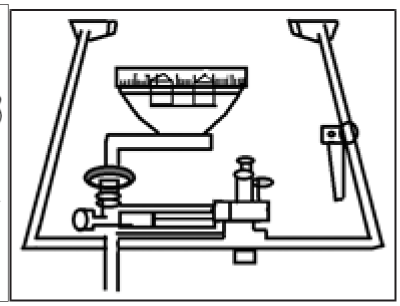



Figure8: Graph grid frame attached to spring bow
Figure9: Modified Hanau wide- view spring bow

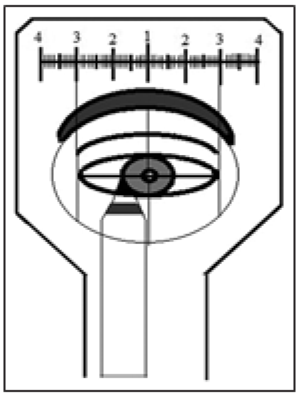
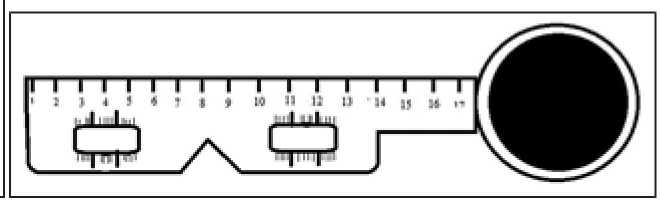



Figure10: Customized scale **Figure11:**Pupillary distanceruler

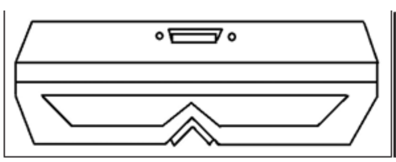
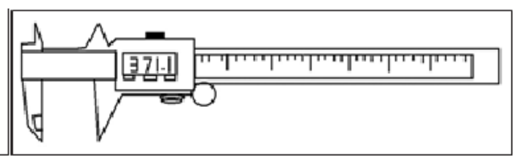



Figure12: Optical vernier inter pupillary distance ruler **Figure13:**Electronicverniercaliper

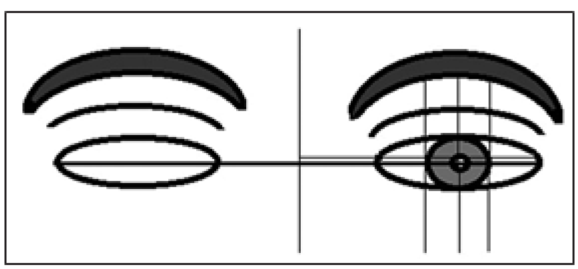


Figure14: Digital photograph

VI. Summary

Precise positioning of Iris is a key to the esthetic ocular prosthesis. There are varied techniques to position iris in the prosthetic eye. The newer techniques have surpassed the lacunae of older ones. Due to insufficient count of well-structured and long-term prospective studies, a comment over the longevity interms of the outcome of the various techniques for iris centering can hardly be given.

VII. Conclusion

However, it can be concluded that the digital approach for iris positioning such as digital photography provides an edge over other techniques. It can be considered as the best available technique that can be used even in caseswith facial asymmetry and can be used without complex armamentarium, patient cooperation, and assistance.

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