Anterior Lamellar Keratoplasty Assisted by IntraLase™ Femtosecond Laser in a Pediatric Patient

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ABSTRACT
A 14-year-old boy affected by keratoconus underwent an anterior lamellar keratoplasty assisted by IntraLase femtosecond laser (Abbott Medical Optics, Abbott Park, IL). Results after 2 years of follow-up indicate the procedure may be safe and effective in pediatric patients.

INTRODUCTION
The femtosecond solid-state laser has been successfully used in several corneal surgical procedures. The technology consists of an infrared Nd:Glass laser beam focused at a desired corneal depth to induce optical breakdown (called photodisruption) without thermal or shockwave damage to the surrounding tissue, which particularly improves the reproducibility and outcomes of lamellar surgery. The femtosecond laser technology of the 60-kHz IntraLase system (Abbott Medical Optics, Abbott Park, IL) facilitates flap creation in laser in situ keratomileusis, the creation of arcuate incisions and channels for intracorneal rings, and the preparation of donor and host tissue for the anterior, posterior, and penetrating keratoplasty, the so-called IntraLase Enabled Keratoplasty. We report a 2-year follow-up after an anterior lamellar keratoplasty performed on a 14-year-old boy affected by keratoconus.

CASE REPORT
A 14-year-old boy affected by keratoconus (stage 3-4, Oculus Pentacam; Oculus, Wetzlar, Germany) (Fig. 1) underwent anterior lamellar keratoplasty assisted by IntraLase under topical anesthesia. All experimental investigations reported here were performed with informed consent and followed all guidelines for experimental investigation with human subjects required by the authors’ institution. The surgery and follow-up were performed at the Hospital Casa Sollievo della Sofferenza of San Giovanni Rotondo, Italy. All surgery was performed in the operating room where the IntraLase femtosecond laser is positioned. Because the patient appeared eligible, both laser and surgical treatments were performed under topical anesthesia. The patient tolerated this type of anesthesia well until the positioning of the last stitches; however, a continuous dialogue between surgeon and patient provided a perfect conclusion of the surgery. The surgeon met with the patient and his parents before the surgery, explaining at great length the different steps of the procedure and verifying the compatibility of the patient with the topical anesthesia. The surgical treatment was planned when the patient could no longer tolerate contact lenses.

Preoperatively, the best-corrected visual acuity (BCVA) was 0.1. The preoperative corneal parameters measured by the Oculus Pentacam are as follows: mean topographic keratometry was 62.3 diopters, topographic astigmatism was 7.2 diopters, and central pupil pachymetry, corneal apex pachymetry, and thinnest point were 415, 343, and 308 µm, respectively. To create the donor lamella, the cut was performed on the corneoscleral rim, analyzed, processed by an ocu-
lar tissue bank, and mounted on an artificial anterior chamber (Coronet Patient Artificial Anterior Chamber; Network Medical Products Ltd., North Yorkshire, UK). The 60-KHz IntraLase femtosecond laser created the donor lamella (thickness 350 µm; diameter 8.2 mm; side cut 70°) and the recipient lamella (thickness 110 µm; diameter 8.0 mm; side cut 70°). The recipient lamella was then gently removed and the donor lamella was fitted into place and sutured using 12 interrupted 10-0 nylon sutures. One-, 3-, 6-, 12-, and 24-month postoperative BCVA and topographic astigmatism, 24-month postoperative mean topographic keratometry, central pupil pachymetry, corneal apex pachymetry, and thinnest point were measured.

RESULTS

BCVA and topographic astigmatism were 0.1 and 3 diopters at 1 month, 0.3 and 4.50 diopters at 3 months, 0.5 and 5 diopters at 6 months, 0.6 and 4.50 diopters at 12 months, and 0.7 and 3 diopters at 24 months, respectively. Twenty-four months postoperatively, mean topographic keratometry was 49.6 diopters, whereas central pupil pachymetry, corneal apex pachymetry, and thinnest point were 587, 557, and 513 µm, respectively. Sutures were selectively removed by the eighth postoperative month.

DISCUSSION

Several authors have observed the high precision of the IntraLase femtosecond laser in corneal lamellar surgery. They have reported on the quality and precision of the femtosecond laser engine obtained through lower pulse energy and spot separation settings. The femtosecond laser increases the precision of corneal surgery because of the high reproducibility of cuts performed in donor and host tissue.

The femtosecond laser has been used to perform a new surgical lamellar keratoplasty procedure to create a valid and safe alternative to previous lamellar keratoplasty techniques and to find a repeatable, more predictable, and simple surgical technique suitable for every surgical skill. Moreover, this new technique seems to have no limits when working with corneal shape, thickness, and curvature abnormalities that are commonly found in other lamellar keratoplasty techniques.
In our case, we applied the surgical procedure previously used for adults to a pediatric patient. As observed in older patients, the anterior lamellar keratoplasty assisted by the IntraLase femtosecond laser led to an improvement of corneal transparency, thickness, and shape, restoring the corneal optical integrity and structure (Figs. 2 and 3). The regularity and homogeneity of the femtosecond laser cut and a smooth and precise recipient bed surface results in a better fit of the donor cornea and good refractive outcomes. The wound heals better and the suture-induced astigmatism is reduced compared with the penetrating keratoplasty.

After selective suture removal, BCVA gradually increased for a period of time, reaching 0.7 at 24 months. The progressive visual recovery could be related to the resolution of deep stromal folds observed in the early postoperative period by confocal microscopy because of stabilization of biomechanical corneal forces and structural stromal rearrangement. However, the visual recovery could be affected by the presence of an interface between donor and recipient lamella.

Our long-term follow-up suggests that anterior lamellar keratoplasty assisted by IntraLase femtosecond laser could also be a safe and effective procedure in pediatric patients to avoid all intraoperative and postoperative complications and the high risk of graft rejection or delayed failure of the graft seen in penetrating keratoplasty.

REFERENCES

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