Autolimbal grafting in penetrating ocular injuries with limbal involvement

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Background: *A penetrating ocular injury with limbal involvement leads to limbal stem cell deficiency and poor corneal regeneration.*
Purpose: *To assess treatment outcomes of primary surgical repair (PSR) involving autolimbal grafting versus conventional PSR in penetrating ocular injuries with limbal involvement.*
Materials and Methods: *Patients were retrospectively divided into two groups comparable in age, type of trauma and time from injury to admittance. Group 1 comprised 26 patients (26 eyes) who had PSR with autolimbal grafting, while Group 2 (the control group) comprised 24 patients (24 eyes) who had conventional PSR for penetrating ocular injuries with limbal involvement. Wound margin state, scar formation period, regression of inflammatory response, and presence of vascularized scar were used as outcome measures.*
Results: *After treatment, the number of eyes with visual acuity of 0.1 or better was 19 (73.08%; including 12 eyes (46.2±6.5%) with visual acuity of 0.7 to 0.9) in Group 1 versus 5 (20.8±6.6%) in the control group.*
Conclusion: *The proposed technique of PSR with autolimbal grafting for penetrating injuries with limbal involvement demonstrated advanced correction for wound margin adaptation and resulted in faster wound regeneration.*

Introduction

A penetrating corneal injury with limbal involvement leads to limbal stem cell deficiency and poor corneal regeneration, which is usually followed by development of superficial and deep corneal vascularization, coarse scars, keratopathy, etc., even in the most thorough primary surgical repair (PSR) [1, 2]. Although aimed at preserving the anatomical integrity of the eye, surgical techniques for penetrating injuries (especially for wounds involving both the cornea and the sclera) do not eliminate the above mentioned complications [3-5].

The discovery of limbal stem cells has contributed to a revision of our understanding of a number of pathological ocular conditions, including those related to ocular surgery [6-8].

Therefore, improvement of primary surgical repair is of special importance for improving treatment outcomes in penetrating corneoscleral injuries.

The purpose of this study was to assess treatment outcomes of PSR involving autolimbal grafting versus conventional PSR in penetrating ocular injuries with limbal involvement.

Materials and Methods

We retrospectively reviewed the records of 50 patients (50 eyes) who sustained a penetrating corneal injury with limbal involvement.

Group 1 comprised 26 patients (26 eyes) who had undergone PSR involving autolimbal grafting after meticulous fixation with sutures. Group 2 (the control group) comprised 26 patients (26 eyes) who had undergone conventional PSR. All patients were admitted to the emergency department within two days after injury.

Out of 26 patients of Group 1, 17 (65.38%) were admitted within 24 hours, and 9 (34.62%) were admitted within 24 to 48 hours after injury. Fifteen (62.50%) и 9 (37.50%) of the controls were admitted to hospital within 24 hours and within 24 to 48 hours after injury, respectively. Patients of Group 1 and Group 2 were comparable in age, sex, type of injury and time from injury to admittance.

At baseline, there was no statistically significant difference in location (p=0.96), size (p = 0.46) or the nature (p=0.49) of the penetrating eye wound, or in visual acuity at admission (p=0.80) between patients of the two groups. In both groups, the size of the penetrating wound varied from 6 mm to 8 mm, and the wound margins were uneven and usually edematous. In addition, iris and/or ciliary incarceration or prolapse was observed in 30.8% and 25.0% of the patients of Group 1 and Group 2, respectively. Furthermore, in a quarter of patients, there was the presence of a retained foreign body in the wound, which caused microdefects in the corneal and limbal tissue.

On admittance to the clinic, edema and infiltration of the margin of the corneolimbal segment of the wound were observed to a greater or less extent in 21 patients (80.77%) of Group 1. However, no case of purulent wound infiltration was observed. The extent of wound margin edema was greater in cases with severe trauma, foreign body, uveal prolapse, and depended also on the interval between injury and admittance to hospital. Out of 9 patients of Group 1 admitted within 24 to 48 hours after injury, 8 patients had a wound margin edema; furthermore, the edema was substantial in 3 of these patients.

Most commonly, patients of either group had corneolimbal or corneoscleral wounds, with a corneal wound surface segment being more extensive.

In most of the patients, the wound was complicated by damage to deeper internal ocular structures like iris rupture (11 patients (42.31%) of Group 1 and 9 patients (37.50%) of Group 2), prolapsed or locally-crushed ciliary body (6 patients (23.08%) of Group 1 and 5 patients (20.83%) of Group 2), traumatic cataract (14 patients (53.85%) of Group 1 and 11 patients (45.83%) of Group 2), vitreous hemorrhage (17 patients (65.38%) of Group 1 and 16 patients (66.67%) of Group 2), and the presence of IOFB (5 patients (19.23%) of Group 1 and 5 patients (20.83%) of Group 2).

The method of PSR consisted in closing the penetrated wound with interrupted superficial sutures. This was preceded when indicated by the following: (1) the piece of iris and/or ciliary body prolapsed was either removed if unviable or repositioned (8 patients (30.8%) of Group 1 and 6 patients (25.08%) of Group 2), (2) evacuation of hyphema was performed (15 patients (57.7%) of Group 1 and 11 patients (45.8%) of Group 2), (3) the damaged lens was extracted (6 patients (23.1%) of Group 1 and 5 patients (20.8%) of Group 2), (4) anterior vitrectomy for vitreous hemorrhage was performed (14 patients (53.8%) of Group 1 and 11 patients (45.8%) of Group 2).

In patients of Group 1, conventional suturing of the penetrated wound was followed by covering the limbal portion of the wound with the autolimbal graft raised from the unaffected portion of the limbus of the traumatized eye. The graft (width of the conjunctival portion, 2-3 mm; width of the corneal portion, < 1 mm; thickness, 0.2 mm; length: somewhat longer than that of the limbal wound) was cut with a crescent bevel up knife, placed onto the limbal portion of the prepared wound site, and fixed with overlying sutures (10-0 in size). Antibiotic agent with dexamethasone was injected subconjunctivally, and aseptic dressing was applied to both eyes immediately after grafting procedure.

The surgery was of emergency nature in all cases. In addition, conventional medical therapy was administered (periocular antibiotic injections, periocular dexamethasone injections, periocular vasoprotective agents, antimicrobial drops, non-steroidal anti-inflammatory drops, and antimicrobial ointment).

Wound margin state, scar formation period, regression of inflammatory response, and presence of vascularized scar were used as outcome measures.

Patients underwent visual acuity testing, gonioscopy and biomicroscopy. The follow-up duration was up to 3 months from surgery.

Results and Discussion

At day 1 after PSR, the numbers of patients with moderate infiltration and with marked infiltration of the margin of the adapted wound in Group 1 decreased from 17 (65.38%) to 4 (15.38%) and from 5 (19.23%) до 3 (11.54%), respectively. At day 5, moderate edema persisted in 2 patients (7.69%), and edema was either absent or mild (6 patients; 23.08%) in other patients in this group. By day 7, the wound margins were transparent or semitransparent in all patients of Group 1.

By days 1, 5 and 7, the numbers of patients with infiltration of the margin of the wound in the control group were 20 (83.33%; i.e., the majority of patients), 16 (66.67%) and 11 (45.83%; i.e., almost half of patients), respectively. The wound margins became semitransparent in 18 patients (75.0%) of the control group as late as week 2.

The regression period of posttraumatic iridocyclitis had some special features. Thus, at day 3, mild to moderate iridocyclitis was noted in a substantial percentage (19 (73.08%)) of patients, whereas severe iridocyclitis was observed in 3 cases (11.54%) of Group 1. Severe anterior uveitis was predominant (75%) in the control group. At day 5, the numbers of patients with iridocyclitis decreased to 12 (48.08%; i.e., almost twofold) in Group 1 versus 15 (62.50%) in the control group. By day 10, the signs of iridocyclitis observed were limited (to conjunctival injection and/or tenderness to palpation of the globe) or absent in all patients of Group 1. By day 14, the signs of a mild inflammatory process persisted in 2 patients (7.69%) of Group 1 versus 10 patients (41.67%) of the control group.

Healing periods for penetrating wounds were assessed by the type and time required for the formation of the visible portion of the scar. The outcomes experienced by patients treated with the proposed PCR technique were advantageous compared to conventional technique with regard to healing periods for penetrating wounds with limbal involvement. Thus, by day 14, scar formation was complete in 17 patients (65.4±6.3%) of Group 1 versus 10 patients (41.67±8.0%) of the control group. By day 21, corneolimbal scar formation was complete in patients of either group.

It should be noted that in patients of Group 1, the scar was thinner, not prominent and transparent, with low number of complications like anterior synechiae and vascularization, compared to that in patients of the control group.

By week 3, in patients of Group 1, the scar appeared as a thin and not prominent linear opacity, the graft could not be visually identified, and no case of vascularization of the scar was observed. At month 3, the scar was thin, with transparent corneal tissue around it, and the anterior chamber angle was open. In addition, a few isolated tender synechiae and hyperpigmentation were observed in 3 patients and 5 patients, respectively.

At week 3, scar formation was complete in almost all patients of the control group. The scar was prominent; corneal stromal edema, different degrees of scar vascularization, and edematous corneal tissue around the scar were observed in almost all cases of the group. At month 3, the coalescent scar with vascularization, closed anterior chamber angle and wide synechiae were observed in almost all operated eyes of the control group.

The visual function was better in operated eyes of Group 1 than in those of the control group due to better anatomic outcomes. After treatment, the number of eyes with visual acuity of 0.1 or better was 19 (73.08%; including 12 eyes (46.2±6.5%) with visual acuity of 0.7 to 0.9) in Group 1 versus 5 (20.8±6.6%) in the control group.

Conclusion

First, the technique of PSR with autolimbal grafting for penetrating wounds with limbal involvement promotes advanced correction for wound margin adaptation, reparative processes, and reduction in vascularization and inflammatory response. In addition, a comparative analysis of the new and conventional techniques demonstrated that the former is more effective in treating the wound.

Second, the proposed technique offers a shorter regeneration period for penetrating wounds with limbal involvement.

Finally, the technique is simple and requires neither expensive studies nor extra equipment, and can be used in any ocular surgery department.

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