

Radiofrequency ablation micro-dissecting of eyelid nevus with XL-RFA device under operating microscope

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Abstract

• **AIM:** To study the effect of an innovative micro-dissection procedure by radiofrequency ablation (MRA) in removing eyelid nevus.

• **METHODS:** Fifty-six consecutive outpatients with eyelid nevus were treated with MRA using a monopolar device. The effect of MRA was determined after following-up for 6mo to 5y.

• **RESULTS:** Fifty-two cases (52 eyes, 92.9%) were cured once, and 4 cases (4 eyes, 7.1%) received second treatment for small residual. All cases healed well after surgery, with no pigmentation, no scars, no loss of eyelashes, no deformation of eyelid margin. There was no visual impairment after healing.

• **CONCLUSION:** MRA of eyelid nevus using the XL-RFA device is highly efficient without significant complications.

• **KEYWORDS:** radiofrequency ablation; micro-dissecting; eyelid nevus

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INTRODUCTION

Eyelid nevus is a type of neoplasm. The main contents are nevus cells, the most of which was melanocyte^[1]. The

nevus is located either subdermal or a pigmented growth on the skin. Melanin is responsible for their dark color. The cause is not clearly understood. Sunlight and hormones maybe another two factors which may cause nevus. The prevalence of eyelid nevus in Asian population ranged from 8.6% to 12.1%^[2].

Because of the troublesome location and affecting facial beauty caused by eyelid nevus, patients usually seek for a removal of it. The common procedures to remove the eyelid nevus are surgical excision and laser treatment. However, they are generally not well-accepted by patients. Surgery is a common ophthalmology, but surgical excision of eyelid nevus has some difficulties and may pose some risks, such as defect and deformation of eyelid margin. Postoperative complications may include deformation caused by eyelid margin defect or scar formation. The laser treatment, with low controllability, prone to induce massive collateral injury, including deformation, corneal damage and eyelash loss, etc^[2].

Radiofrequency ablation has been used in many minimal invasive procedure. For example, it was used to eradicate arrhythmia in heart diseases. Radiofrequency ablation has different effects under various temperature. It causes contacting tissue molecular oscillation by electromagnetic wave passing through the treatment electrode. It has a good hemostatic effect on the ablated tissue. Radiofrequency ablation has been shown to have multiple advantages over traditional operational methods with feasibility of accurate control, less collateral damage and limited complications. The technique has been used in treating venous malformation^[3-4], knee osteoarthritis^[5] palpebral margin neoplasm^[6] and periorbital syringomas^[7]. But till now, no studies reported the effectiveness of radiofrequency ablation in eyelid nevus treatment. In present study, we aimed to examine the efficacy of the innovative radiofrequency ablation device in the removal of eyelid nevus.

SUBJECTS AND METHODS

Ethical Approval All participants gave informed consent to take part in the study. The study protocol was approved by the Institutional Review Board of Chinese PLA General Hospital (No.413EG642) and was conducted in accordance with the Declaration of Helsinki.

Subjects A total of 56 patients from the Clinic of Ophthalmology and Rehabilitation in Chinese PLA General Hospital from

2013 to 2018 were recruited. The inclusion criteria are as followed: 1) diagnosed eyelid nevus; 2) informed consent form signature confirmed. The exclusion criteria are 1) obvious diseases which may affect ablation; 2) combined other eye diseases. The characteristics of the disease's distribution and size were collected. The characteristic information including age and gender, *etc*, was recorded. A digital camera was used to take photos of lesion locations prior and posterior to treatment. Among the 56 included subjects, 10 were male and 46 were female. Their age ranged from 11 to 71y, with an average of 39.9y. The course of disease varied from 2 to 51y, with an average course of 21.4y.

Treatment Device Patients were treated with a monopolar device (XL-RFA device invented by Xing-Lin Wang from Chinese PLA General Hospital). The instrument has been authorized by State Food and Drug Administration of China (CFDA; No.2250584). The radiofrequency electrodes aligned with eyelid nevus, removed the lesions and melanocytes from the nevus nest along the border of diseased tissue by micro-dissection radiofrequency ablation (MRA) technique.

Treatment Protocol The 5% iodophor conventionally disinfected the skin, and 2% lidocaine was used for infiltration anesthesia. The treatment was performed under 2.5 loupe magnifications using XL-RFA device. During the process, the operators can observe whether there was any residue, whether the radian of margin was smooth, and removing the lesion into bottom to firm a solidified protective layer. Besides, some tissues were taken with tweezers for pathological examination. After the first treatment, the patients were informed of postoperative precautions, such as keeping the wound clean and waiting for natural healing after crust falling off. The residue was removed again in selected days.

Therapeutic Evaluation The curative effect was divided into 5 categories: recovered, markedly improved, effective, failed and aggravated. The standards were as followed: 1) recovered: the eyelid nevus completely disappeared with the normal palpebral margin, no scars and no recurred in the next 3mo; 2) markedly improved: the eyelid nevus disappeared with a defect <1 mm on the palpebral margin; 3) effective: 2/3 of the eyelid nevus disappeared, the residue was less than 1/3 or recurred in the next 6mo; 4) failed: the eyelid nevus was almost unchanged; 5) aggravated: the eyelid nevus increased more than 10% after removal. Anyone who had residual need a second treatment.

RESULTS

Distribution of Eyelid Nevus Of the 56 patients (56 eyes), 32 cases were in the right side and 24 cases in the left; 21 cases in upper eyelid, 35 cases in lower eyelid. Male patients accounted for 17.9%. The mean age was 40.4 ± 7.5 y in men and in 39.8 ± 12.5 y in women. Only one case had inner canthus eyelid

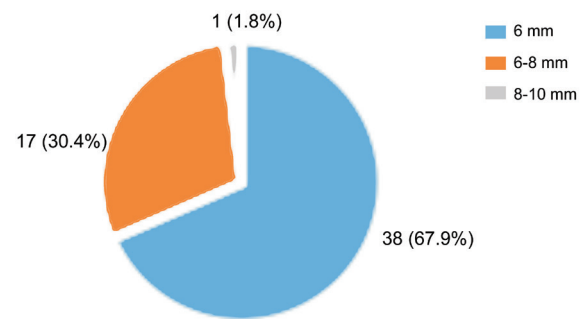


Figure 1 The distribution of eyelid nevus size.

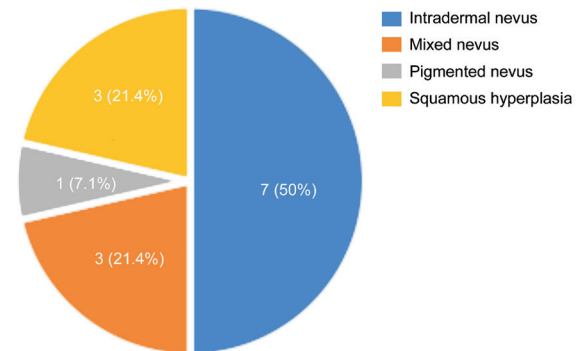


Figure 2 The distribution of eyelid nevus pathological biopsy.

nevus. The lesion sizes were different. There were 38 cases with diameter less than 6 mm, 17 cases with diameter between 6 to 8 mm, 1 case with diameter between 8 to 10 mm (Figure 1). The 17 cases crossed gray line and mucosa. The total number of patients with gray line infiltration was 49 which accounted for 87.5%. Nine cases involved 1 to 2.5 mm deep within mucosa. Two cases had foreign body sensation and partly affected the visual field (Table 1).

Effect of MRA Treatment Fifty-two cases (52 eyes, 92.9%) were cured once, and 4 cases (4 eyes, 7.1%) had a small residual after first treatment for whom a retreatment was sorted. One case was remarkable once, but one case recurred. The first cure rate was 92.9%. After MRA, the pain of affected eyelids was not obvious. After the treatment, the wounds became scarred next day, and healed with scars fell off after 7 to 15d. No infection occurred, and no cases of malignant transformation due to MRA were found during follow-up. The mean follow-up time was 2.5y (0.2-5y). All cases healed well after surgery, with good eyelid radian, no obvious side effects, including defect and deformation of margin, scars, loss of eyelashes, deformation of eyelid margin, visible removal after healing, corneal epithelial injury. The results of pathological biopsy were intradermal nevus, mixed nevus and pigmented nevus. No malignant lesions were found (Figure 2).

Typical Cases

Case 1: Eyelid nevus on lower right A 48-year-old woman presented with eyelid nevus on the lower right palpebral margin, size: 4.0×2.5 -mm², crossed the gray line and involved in 2 mm deep within mucosa (Figure 3A). At the 11th month

Radiofrequency ablation micro-dissecting of eyelid nevus

Table 1 Summary of results

| Patient | Age (y) | Sex | Location of margin | Size (mm ²) | CD (y) | Cross gray line and mucosa | Follow-up (y) | Once cured |
|---------|---------|-----|--------------------|-------------------------|--------|----------------------------|---------------|------------|
| 1 | 20 | F | Right-upper | 5×4 | 20 | N | 0.2 | Y |
| 2 | 48 | F | Right-upper | 8×5 | 30 | N | 0.2 | Y |
| 3 | 32 | F | Left-upper | 3×3 | 20 | N | 1 | N |
| 4 | 58 | M | Right-upper | 6×3 | 20 | N | 5 | Y |
| 5 | 43 | M | Right-upper | 6.5×5 | 20 | N | 1 | Y |
| 6 | 33 | F | Right-upper | 4.5×4 | 5 | N | 1 | Y |
| 7 | 43 | M | Left-lower | 1×2 | 20 | N | 1 | Y |
| 8 | 11 | F | Right-lower | 6.5×4 | 11 | N | 1 | Y |
| 9 | 43 | F | Right-lower | 2×2 | 20 | Y | 1 | Y |
| 10 | 36 | F | Right-lower | 2×2 | 36 | Y | 1 | N |
| 11 | 37 | F | Right-lower | 3×3 | 37 | Y | 1 | Y |
| 12 | 24 | F | Right-lower | 3×3 | 24 | N | - | Y |
| 13 | 20 | F | Right-lower | 9×7 | 20 | Y | - | Y |
| 14 | 34 | F | Right-lower | 3.5×3.5 | 34 | N | - | Y |
| 15 | 38 | F | Left-lower | 1.5×1.5 | 24 | N | - | Y |
| 16 | 32 | M | Left-upper | 5×5 | 10 | N | - | Y |
| 17 | 46 | F | Right-lower | 6×6 | 20 | Y | - | Y |
| 18 | 33 | F | Right-lower | 7×5 | 33 | N | - | Y |
| 19 | 42 | F | Right-upper | 6×3 | 42 | N | - | Y |
| 20 | 39 | M | Right-lower | 7×7 | 39 | N | - | Y |
| 21 | 46 | F | Right-upper | 4×4 | 10 | N | 2 | Y |
| 22 | 58 | F | Left-lower | 7×5 | 40 | N | 2 | N |
| 23 | 29 | F | Left inner canthus | 5×5 | 25 | N | 2 | Y |
| 24 | 51 | F | Left-lower | 7×5 | 51 | N | 1.1 | Y |
| 25 | 37 | F | Left-upper | 7×5 | 37 | N | 2 | Y |
| 26 | 37 | F | Left-lower | 5×5 | 10 | N | 2.5 | Y |
| 27 | 43 | F | Right-lower | 2×1.5 | 30 | Y | 2.5 | Y |
| 28 | 69 | F | Right-lower | 7×4 | 14 | N | - | Y |
| 29 | 71 | F | Right-lower | 3.5×2.5 | 10 | Y | - | Y |
| 30 | 34 | F | Left-lower | 4×3 | 30 | N | - | Y |
| 31 | 25 | F | Right-lower | 2×2 | 20 | Y | - | Y |
| 32 | 44 | M | Left-lower | 4.5×3.5 | 10 | N | - | Y |
| 33 | 42 | F | Right-upper | 4×3 | 6 | N | - | Y |
| 34 | 62 | F | Left-lower | 4×3 | 20 | N | - | Y |
| 35 | 40 | F | Left-lower | 4×2 | 21 | N | - | Y |
| 36 | 35 | M | Left-lower | 4×2 | 20 | Y | 5 | Y |
| 37 | 41 | F | Right-upper | 4×3 | 6 | N | 5 | Y |
| 38 | 38 | F | Right-upper | 6×4 | 20 | N | - | Y |
| 39 | 27 | F | Right-lower | 5×5 | 20 | Y | 5 | N |
| 40 | 48 | F | Right-lower | 4×2.5 | 8 | Y | 3 | Y |
| 41 | 30 | F | Left-upper | 6×4 | 10 | N | 5 | Y |
| 42 | 58 | F | Left-upper | 5×4 | 20 | N | 5 | Y |
| 43 | 44 | M | Left-lower | 3.5×3.5 | 40 | N | 1.7 | Y |
| 44 | 37 | F | Left-upper | 5×3.5 | 18 | N | 3 | Y |
| 45 | 43 | F | Left-lower | 4×3.5 | 28 | Y | 0.25 | Y |
| 46 | 42 | F | Left-lower | 7×4 | 42 | Y | 5 | Y |
| 47 | 50 | F | Right-upper | 8×5 | 50 | Y | 5 | Y |
| 48 | 42 | F | Right-upper | 4×3 | 10 | N | 5 | Y |
| 49 | 56 | F | Right-lower | 3×3 | 10 | N | 1 | Y |
| 50 | 31 | M | Right-lower | 3.5×2.5 | 2 | Y | - | Y |
| 51 | 26 | F | Right-lower | 3×2.5 | 2 | Y | - | Y |
| 52 | 31 | F | Left-upper | 7×3 | 7 | N | - | Y |
| 53 | 43 | F | Left-upper | 4×4 | 8 | N | 2 | Y |
| 54 | 35 | M | Left-upper | 3×3 | 35 | N | - | Y |
| 55 | 41 | F | Left-lower | 3×3 | 5 | Y | - | Y |
| 56 | 26 | F | Right-lower | 3×3 | 20 | N | 5 | Y |

CD: Course of disease.

after the first operation, the lesion on the lower right palpebral margin was completely eradicated with no deformation of eyelid margin, no loss of eyelashes, no scars and no visible removal (Figure 3B).

Case 2: Eyelid nevus on lower left A 51-year-old woman presented with eyelid nevus on the lower left palpebral margin, size: $7 \times 5\text{-mm}^2$, crossed the gray line (Figure 4A). At the 27th month after the first operation, the lesion on the lower left palpebral margin was completely eradicated with no deformation of eyelid margin, no loss of eyelashes, no scars and no visible removal (Figure 4B).

Case 3: Eyelid nevus on upper left A 43-year-old woman presented with eyelid nevus on the upper left palpebral margin, diameter: 4 mm, crossed the gray line (Figure 5A). At the 6.5mo after the first operation, the lesion on the upper left palpebral margin was completely eradicated with no deformation of eyelid margin, no loss of eyelashes, no scars and no visible removal (Figure 5B).

DISCUSSION

The eyelid margin is a fibrous arc-like structure which plays an important role in maintaining human appearance. As a transition zone between skin and mucosa, eyelid margin is also a common site of orbital lesion. The thickness of the eyelid nevus is about 2 mm. When removing the pigmented nevus on the eyelid, the accuracy of controlled removal is crucial. Once slightly injured, the margin would be deformed, which will affect the facial appearance. At present, the main treatment option of eyelid nevus is surgery^[8]. The lesion tissue would be cut completely with reliable pathological reports by surgeons. After large eyelid nevus excision, suture can be challenged because of significant tissue loss. A skin graft is usually inevitable. However, even reluctant suture, the eyeball is squeezed to deform. Sub-optimal suture may induce trichiasis. Besides, the cornea reaction stimulated by nesis and marginal deformity caused by formation of scars after surgery are also common side effects^[9].

In the removal of eyelid nevus, some scholars have used CO₂ laser treatment^[8]. CO₂ laser treatment has the advantages of simplicity and effectiveness. But location of lesion's removal during operation relies on visible light control but with poor controllability and low precision. Surgeons are required to wear protective glasses because of flashed light and smoke during laser treatment and it is easy to have residue and complications^[10-13]. Domestic researchers have reported about the curative effect using high-energy ultra-pulsed CO₂ laser treatment on palpebral margin neoplasm. There were 2 cases of corneal damage while cured by treatment, 10 cases of eyelashes loss on the wound surface^[14]. It has been reported that the use of laser for orbital plastic surgery can cause dry eyes. Eye dryness symptoms appear after laser treatment

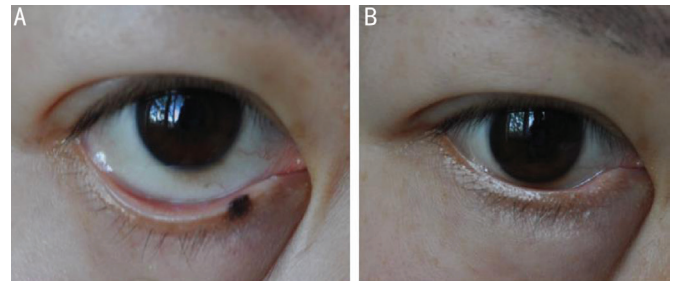


Figure 3 Clinical appearance in patient No.40 before and after treatment A: Before the treatment, the size of eyelid nevus (right-lower) was $4.0 \times 2.5\text{-mm}^2$; B: After treatment, the eyelid nevus completely removed.

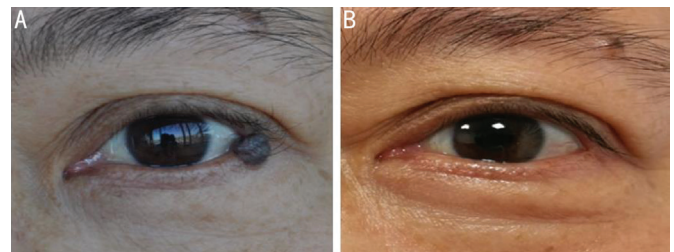


Figure 4 Clinical appearance in patient No.24 before and after treatment A: Before the treatment, the size of eyelid nevus (left-lower) was $7 \times 5\text{-mm}^2$; B: After treatment, the eyelid nevus completely removed.

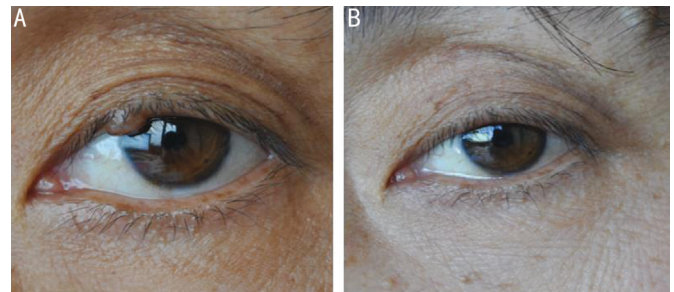


Figure 5 Clinical appearance in patient No.53 before and after treatment A: Before the treatment, the diameter of eyelid nevus (left-upper) was 4 mm; B: After treatment, the eyelid nevus completely removed.

for 1wk to 4mo. Some patients with exposure keratopathy caused by laser treatment need surgical correction of orbital malformation and rabbit eye disease in order to significantly improve the symptoms of dry eyes^[15]. Hammes *et al*^[16] reported that the use of pulsed dye laser to treat wine cockroaches which did not protect the patient's eyes and pupillary motor dysfunction and hypersensitivity to light appeared without completely relieved during 1y of observation. Therefore, surgeons and patients should wear protective lens to protect the eyes when removing eyelid lesions, and keep the laser at a safe distance from the eyeball during laser treatment. Hence, it is a challenging procedure to remove eyelid nevus for surgeons. Radiofrequency ablation has the advantage of surgery, namely makes the excision controlled under the microscope to become a micro-dissection^[17]. Therefore, we have combined ablation

and micro-dissection to create MRA technique to remove the eyelid nevus, which avoiding the above-mentioned side effects, and significantly increasing patients' acceptance and satisfaction. Besides, radiofrequency ablation would not affect lacrimal punctum if near the lesion. Under microscope, the micro-cutting edge can be precisely ablated, and the damage is mild. Because the radiofrequency electrode contacts the tissue to produce ablation, it's easy to control, and it causes no damage to adjacent untouched tissue, such as eyeball, which obviously improves the safety and accuracy of the operation. During the operation, the surgeon does not need to wear any protective glasses, and operations under surgical microscope could obviously improves the clarity of the visual field and make the operation more convenient^[18]. At the same time, radiofrequency ablation avoids suture and its associated adverse post-operation complications.

The grayish white line in the middle of eyelid margin is gray line, which divided the margin into front and back lip. It is common that the lesion involves gray line. The mucous membrane involvement which cross the gray line means that the lesion grows on the gray line and involves in the mucosa. In the present study, 17 cases had lesions crossed the gray line and mucosa. The total number of patients with gray line infiltration was 49 which accounted for 87.5%. Nine cases involved in 1 to 2.5 mm deep within mucosa. To remove such lesions, it is necessary to accurately control the extent and depth of the lesions. If it is too deep, there is a risk of eyelid margin breaking-down, causing defect and deformation of eyelid margin. Operating under a microscope, the precision of removal is significantly improved. There are 17 patients fit for the condition. In these patients, we all have accurately removed lesions without defect and deformation. After lesion removed, there is only tiny crust formed on the mucosa. After treatment, the patient has a slight foreign body sensation of eyeball, and the sensation disappears in 3 to 5d.

The eyelid nevus usually has melanocyte nest infiltrated into margin, and this part of melanocytes has high activity. It is easy to relapse if removal is incomplete. Generally, the eyelid nevus is only about 2 mm thick. It is critical that a complete removal of melanocytes nest should combine with little damage to the margin. By MRA, the normal tissue could be maintained with limited damage when ablate along the border of diseased tissue and normal tissue under the microscope. Through the precise micro-cutting, defect and tissue deformation could be averted.

A 12-year-old child we treated had a recurrence due to the incomplete removal of melanocyte nests. Since the child was developed unstably, we considered the recurrence was derived from regenerated pigmented nevus. No suture was needed after the treatment. No ischemia happened with tension caused by suture. No local blood was affected. Thus, MRA technique can

ensure nutrition support to regenerate tissues and avoid local scar hyperplasia. The therapeutic effect after follow-up was no visible removal after healing. Therefore, MRA technique using XL-RFA device can eliminate the pathological tissue with minimal damage^[14].

Other physical ways such as laser can also cause recur even if small pigmented nevus removed. The reason is that some pigmented nevus has a melanocytes nest that protrudes into or lies on the dermis. If the melanocyte nest is not completely eradicated, the pigmented nevus will recur^[19-20]. Repeated laser treatment has the potential of malignance. Therefore, it's not strongly recommended to remove pigmented nevus using laser. Because of the special location and large damage to eyelid nevus, it is easy to cause defect of eyelid margin and scar healing. Methods such as laser have low precision and have no effects on removing melanocyte nests during treatment, which may lead to recurrence. However, MRA technique assisted by microscope, without flashed light and smoke, can provide the surgeon with good vision on the depth of the pigmented nevus and render a precise ablation and removal of the root and edge of pigmented nevus, which enjoy significant advantages over laser removal. Some large pigmented nevi protrude from the eyelid margin, and there may be abundant blood supply under the skin. It is easy to bleed when removed. However, the MRA technique could prevent bleeding of the wound surface and enable a solid layer protection. The visual field was clear, and only one patient recurred in 56 patients (recurrence rate =1.85%).

The XL-RFA device has been used in our center for more than 10y. The technique has been used in treating many diseases, such as venous malformation^[3], palpebral margin neoplasm^[4] and periorbital syringomas^[5]. MRA technique for removal of eyelid nevus has not been reported before. Reports abroad on facial treatment were mainly about non-ablative methods for facial skin wrinkles, which can make skin younger^[21]. Radiofrequency ablation technique was originally used for supraventricular arrhythmia treatment, and further developed for lumbar disc herniation, prostatic hypertrophy, tumor, *etc*. We have reported a single center experience about MRA technique using XL-RFA device to eradicate margin lesions and created a radiofrequency ablation microsurgery. Radiofrequency ablation microsurgery achieves the goal of precise and targeted eradication of lesions. It has multiple advantages, including short treating time, no bleeding during operation, mild collateral damage, forming protective layer on wound after treatment, rapid wound healing, no scar formation, disposable treatment electrode, no cross infection, which meet the need of clinical practice. Meanwhile, it is convenient during the whole operation process, and can accurately remove pathological tissues. Protective glasses are not warranted for

the operators and patients. The postoperative inflammatory reaction was light. Therefore, radiofrequency ablation microsurgery can completely eradicate the eyelid nevus, and make patients achieve aesthetic appearance. Therefore, MRA technique is a highly accurate, practical and effective treatment in removing eyelid nevus, which possesses a potential of clinical recommendation. Further investigations regarding this innovative therapeutic approach is warranted.

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