From the perspective of plastic surgery, 2 key points to be remembered upon resecting a tumor in the facial skin are (1) to remove the tumor completely for preventing recurrence and (2) to make the surgical scar unnoticeable as much as possible. By improving the purse string suture method, we developed a new pentagram suture technique that enables simple and safe suturing of small to large defects with early satisfactory esthetic outcomes. The surgical outcomes of a case series were examined in this report.

Methods: As in drawing a unicursal star, 5 suture sites were marked at specific intervals around the defect area. A needle with 5-0 polydioxanone suture was passed from the subcutaneous tissue to the superficial dermal layer at one site and then from the superficial dermal layer to the subcutaneous layer at the next site, and the process was repeated until the pentagram was complete. When apposition was not tight enough, a couple of external stitches were added using 6-0 nylon suture.

Results: In 13 patients (16 benign or malignant tumors; mean age, 51.1 years) with a mean tumor size of 10.1 ± 5.2 mm and postoperative skin defect diameter of 12.1 ± 8.2 mm, closure did not result in high tension on the suture, and there was reduced mechanical stress at the wound margin. Surgical outcomes were good esthetically at 6 months after surgery without keloid formation or scar contracture. None of the patients had postoperative pain, infection, or tumor recurrence.

Conclusions: This simple alternative method for the closure of facial skin defects after skin tumor excision could be performed easily and provided satisfactory surgical outcomes.

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The purse string suture method has been used as an alternative method, especially for small tumors on the face. The method involves some horizontal dermal stitches in the wound circumference for closing a round skin defect generated by the round surgical excision of a tumor. Without following the relaxed skin tension lines, the purse string suture is more useful for minimizing the surgical scar than conventional spindle-shaped incision. According to Yuen et al., the purse string suture reduces the area of skin defects due to surgical excision by 70%. In addition, the suture is less likely to cause deformation of the structures adjacent to the wound because the wound margin advances evenly to close the skin defect. In addition, compared with other surgical methods such as skin grafting and local flap surgery, which creates a wound in the donor site, the short incisions made by this method are associated with a low risk of postoperative bleeding, even in elderly patients with a bleeding tendency due to, for example, the use of anticoagulants and antiplatelet drugs. However, the purse string suture has disadvantages because (1) the high tensile strength in the skin may damage the suture in patients with large skin defects and (2) it is extremely difficult to perform multiple horizontal dermal stitches after the excision of small tumors.

In light of these facts, based on the theory behind the conventional purse string suture technique, this study developed a new “pentagram suture technique” for achieving simpler, smoother, and safer suturing of skin defects.

**OPERATIVE PROCEDURE**

The schema of the pentagram suture technique is shown in Figure 1. First, an incision was made along the margin of the tumor for excising benign tumors, or an incision was made along the safety resection margin as appropriate for malignant tumors. The subcutaneous fat layer at the margin was then undermined by approximately 5 mm, and as in drawing a unicursal star, suture sites A, B, C, D, and E were marked at specific intervals. A needle with 5-0 polydioxanone (PDS II; Ethicon, Somerville, N.J.) suture was passed from the subcutaneous tissue to the superficial dermal layer at site A in a conventional dermal suturing manner (Fig. 1A). The suture was then passed from the superficial dermal layer into the subcutaneous layer at site B (Fig. 1B) and from the subcutaneous layer into the superficial dermal layer at site C (Fig. 1C). The procedure was repeated at sites D and E (Fig. 1D and E). Finally, the suture was passed from the superficial dermal layer to the subcutaneous layer at approximately 2 mm from original site A, and both ends of suture were pulled to complete the unicursal pentagram (Fig. 1F). At site A, the suture was ligated by making 4 square knots to hide the distal and proximal ends of the suture under the skin (Fig. 1G). When apposition of adjacent tissue was difficult, the surgical

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**Fig. 1.** Schematic illustrations of the sequence of the “pentagram suture technique.” The procedure starts from the left panel in the upper (A–D) and lower (E–H) rows. Marks A to E indicate the stitching points of the skin.
assistant should gather the skin by hand to complete the procedure. Unnatural rippling of the suture site after closure is trimmed off as necessary. When the apposition of the skin was not tight enough, a couple of external stitches might be added using 6-0 nylon suture (Ethilon; Ethicon) (Fig. 1H). Ointment gauze dressing with light compression was applied at the suture site.

Face washing and bathing were allowed from postoperative day 1. At every face washing, the suture site was disinfected with 0.02% benzalkonium chloride, and a simple gauze dressing was applied. External stitches were removed on postoperative day 7, and for the next 3 months, the surgical scar was taped with Micropore Skin Tone surgical tape (3M, Tokyo, Japan). Taping is a technique used during the postoperative period to maintain wound stability and thus prevent stretching of skin around the suture sites, as well as minimize the formation of postoperative scar tissue.

**CLINICAL CASES**

The pentagram suture technique was applied to incision sites after surgical excision of facial skin tumors in 13 patients (16 tumors; 7 men, 6 women; mean age, 51.1 years; age range, 8–89 years). Mean tumor size was 10.1 ± 5.2 mm, and the mean diameter of the postoperative skin defect was 12.1 ± 8.2 mm. Final histopathological findings were intradermal nevus in 10 cases, seborrheic keratosis in 2 cases, and basal cell carcinoma, squamous cell carcinoma, Bowen disease, and capillary hemangioma in 1 case individually. Tumor sites were the cheek in 8 cases, temporal region in 4 cases, glabella in 2 cases, below the eyelid in 1 case, and below the jaw in 1 case. In 3 patients, malignant tumors were excised with appropriate resection margins in accordance with Japanese guidelines for the management of skin cancer, and intraoperative pathological examination was performed to confirm negative resection margins before closing the incision site. Apposition of the pentagram suture sites could be performed in all patients. In addition, for 5 of the 16 tumors, in which the postincision facial skin defect was estimated to be > 20 mm, external stitches were added using 6-0 black nylon suture to prevent the rupture of suture sites.

All operations were performed by an experienced plastic surgeon who is also a surgical instructor specializing in skin tumors. Surgical outcomes were extremely satisfactory from the

![Fig. 2.](image2.jpg) Photographs of a patient who underwent excision of a skin tumor. Case 1: An 89-year-old woman before surgery (A) and following excision of a squamous cell carcinoma in the right cheek. The resulting skin defect was closed by the pentagram suture technique (B), and no suture breakage occurred during closure (C). D, At 6 months after surgery, an extremely small and esthetically satisfactory surgical scar (black arrow) was noted without postoperative complications.
esthetics viewpoint with no keloid formation, dog-ear deformity, or scar contracture during the 6-month follow-up. None of the patients had tumor recurrence.

Case 1
Excision of a squamous cell carcinoma (15 mm) with a 6-mm resection margin was performed in the right cheek of an 89-year-old woman (Fig. 2A). The resulting skin defect (27 mm) was closed by the pentagram suture technique (Fig. 2B). No suture breakage occurred during closure (Fig. 2C). No postoperative infection or ulcer formation was observed during postoperative week 1. At 6 months after surgery, an extremely small and esthetically satisfactory surgical scar (black arrow) was noted without postoperative complications such as local recurrence, keloid formation, or scar contracture (Fig. 2D).

Case 2
Excision of an elevated skin tumor (15 mm) in the left temporal region in a 72-year-old man was performed along the tumor margin under local anesthesia (Fig. 3A). The final pathological diagnosis was seborrheic keratosis. Closure of the resulting skin defect was performed by the pentagram suture technique (Fig. 3B). Closure of the skin defect was performed easily. The patient had no postoperative complaints of impaired eyelid movement or pain (Fig. 3C). As no postoperative infection or ulcer formation was observed during postoperative week 1, the external stitches were removed. At 6 months after surgery, the surgical scar (black arrow) was extremely small and esthetically satisfactory (Fig. 3D), and there was no evidence of postoperative complications such as scar deformity or impaired eyelid movement due to scar contracture.

DISCUSSION
The pentagram suture technique reported here offers a number of advantages over the conventional purse string suture method. First, the tension exerted on the suture is estimated to be relatively small. In the purse string suture (Fig. 4A), the suture is placed at the margin of the round skin defect, and the area of the wound is reduced by the force that shortens the circumference of the margin (red arrows), which is produced by the circular tensions that pull the suture (green arrows). Because all the suture tensions are in the same direction, the load on the suture becomes great with a tendency of breakage of sutures in larger defects or the tissue...
surrounding the suture site may rupture. In contrast, with the pentagram suture technique, the suture tensions (Fig. 4B, green arrows) between the 2 points generate vectors that are directed toward the center (red arrows), enabling the skin defect area to be reduced, similar to the purse string suture. Unlike the purse string suture, however, the present technique was able to close the skin defect without generating a high level of tension on the suture, because the vectors between 2 points were smaller due to their different directions. Consequently, the purse string suture may be more suitable for elderly patients with low tensile strength in the skin (ie, load on the suture is small), and the pentagram suture technique is more suitable for younger patients with higher tension in the skin.

The second advantage of the pentagram suture is thought to be low mechanical stress at the wound margin. Purse string suture requires pulling 2 points (Fig. 5A, marks a-a', b-b', c-c', d-d', and e-e') on the same horizontal plane, which is made during horizontal dermal suturing, to create 1 apex (Fig. 5A, A, B, C, D, and E). When the suture is pulled, the 2 points (eg, a and a') are shifted to one site, but this seems to generate intense mechanical stress on the skin (red triangle areas in Fig. 5B). Consequently, the center of the suture site is compressed greatly after closure, and possible skin compression may lead to a skin circulation problem, ulcer formation, and wound reopening (Fig. 5C). In contrast, with the pentagram suture technique, the apex was formed by conventional vertical dermal suture placed in the wound edge, generating little longitudinal compression through the soft and flexible dermis (Fig. 5D and E). Consequently, unlike the purse string suture, the present technique enabled closure without exerting mechanical stress over the wide area of the wound margin (Fig. 5F). Although the purse string suture carries a risk of wound reopening in patients with poor skin condition, the risks of skin damage and wound reopening were low with the pentagram suture technique.

The third advantage of the technique was its simple suturing technique. With the purse string suture in which dermal stitches are placed horizontal in the wound edge, the procedure is more difficult to perform for smaller defects because of the limitation of needle size. Consequently, the short circumference of small skin defects limits the number of horizontal dermal stitches that can be made. The pentagram suture, however, could be performed for tumors with short circumferences without being affected by the limitation of needle size, and plastic surgeons are accustomed to performing vertical dermal sutures in the technique. Moreover, the number of dermal stitches made in the pentagram suture was easy to remember because everyone is familiar with drawing a unicursal star from childhood. In particular, the pentagram suture could be performed at multiple sites in one surgery without undue stress on surgeons because of its simplicity. With the purse string suture, several months are sometimes necessary before the rippling becomes unnoticeable; thus, surgeons need to inform patients of the possibility of poor esthetic outcome in the early postoperative phase. Similarly, patient education was important for patients undergoing the pentagram suture because rip-
pling was sometimes notable immediately after surgery. Furthermore, when skin defects are present in the lower eyelids or lips, the possibility of complications such as ectropion needs to be considered carefully before performing the pentagram suture.

Further studies with more patients are needed to investigate the maximal tumor diameter for the pentagram suture technique and to examine whether the technique is applicable to other areas of the body where the skin is thicker than facial skin and in pediatric patients with a high tensile strength of the skin.

CONCLUSIONS

Through the improvement of the purse string suture, we developed a pentagram suture technique as an alternative method to close facial skin defects resulting from skin tumor excision. The technique enabled closure of facial skin defects easily and provided esthetically satisfactory surgical outcomes without postoperative infection or scar deformity.

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PATIENT CONSENT

Patients provided written consent for the use of their images.

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Fig. 5. Schema of stress exerted on the skin at the apex and center of the closed skin defect treated with the purse string suture and pentagram suture techniques. In the purse string suture (A, B, C), 1 apex is created from suture points A, B, C, D, and E by pulling 2 points generated by horizontal dermal suturing (marks a-a’, b-b’, c-c’, d-d’, and e-e’). When these pairs of points were pulled, strong mechanical stress is exerted on the skin at the center (red area). As a result, a strong compression is present at the center after closure. With the pentagram suture technique (D, E, F), 1 apex is created from suture points A, B, C, D, and E by dermal suturing vertical to the wound surface with little longitudinal stress through the soft and pliable dermis.