Laminated Dorsal Beam Graft to Eliminate Postoperative Twisting Complications

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Preshaped laminated dorsal beam grafts, cut and shaped, from lyophilized rib cartilage eliminate postoperative complications in the correction of saddle depression procedures; lyophilized rib cartilage does not undergo irradiation. Rhinoplasty surgeons traditionally use monounit rib cartilage to correct saddle depressions. During the 3- to 6-month postoperative recovery period, monounit grafts tend to twist and bend, often undermining the shape of the nose. Secondary or revision surgery entails removal of the monounit cartilage. Grafting material used in laminated form is more resilient and flexible than a single unit of similar material. Two-millimeter-thick rib cartilage strips counteract the distorting tendencies of monounit cartilage most effectively. After estimating the dimensions of the required lamination with soft-solid silicone sizers, rib cartilage strips are shaped and sutured into a lamination and then inserted under the skin–soft tissue envelope into the dorsal depression. Surgery is concluded in the normal manner by closing the transcolumella-incision with 6-0 fast absorbing plain cat gut sutures. Results over 3 years (117 dorsal beam procedures from 2003-2005) documented with medical case history follow-ups and postoperative imagery show that the laminations do not bend or revert to the original shape of the rib. Results 4 years after the introduction of the technique suggest that laminations counter the inherent postoperative distortion tendencies of monounit rib cartilage.

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Laminated dorsal beam grafts made from lyophilized rib cartilage demonstrate a potential to eliminate postoperative complications in the correction of saddle depression procedures. Corrective dorsal beam rhinoplasty using preshaped lyophilized rib cartilage strips laminated and secured with sutures inhibit the postoperative tendency of monounit rib cartilage units to revert to their inherent shape (thereby distorting the result of the procedure). Rhinoplasty surgeons traditionally use monounit rib cartilage to correct saddle depressions in African- or Eastern-shaped noses. I, the senior author (P.F.S.), observed—using monounit cartilage—that during the 3- to 6-month postoperative recovery phase, monounit grafts tended to twist and bend, often undermining the shape of the patient's nose. Consequent secondary or revision surgery often entailed removal of the monounit cartilage.

Dealing with saddle depressions and the augmentation of the dorsum of the nose over a 30-year period, I had used various implants, but found that none of these implants—at least in my hands—adequately fulfilled the purpose of the operation. I subsequently resorted to autograph rib cartilage, and in certain cases, conchal ear cartilage. However, having discarded general anesthesia in 1991 for a conscious sedation technique, which was earlier pioneered at my private prac-

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tice, I could not harvest autograph rib cartilage unless I reverted to general anesthesia.

Having previously concluded that autograph rib cartilage harvesting caused unnecessary donor-site morbidity and that this particular procedure also lengthened the operation (unnecessarily, in my opinion), I opted instead to explore a less dramatic approach to grafting material, using instead lyophilized homograph rib cartilage. I discovered, however, that lyophilized monounit rib cartilage had a tendency to twist postoperatively in relation to the size, length, and thickness of the grafting unit: the bigger, longer, and thicker the unit, the greater the tendency to twist. The result invariably required revision surgery to correct the ensuing distortion of the patient's nose.

Reflecting on these distortions, I wondered whether thin layers of rib cartilage sutured together would counteract the twisting tendencies of the monounit cartilage grafts. It is a known and accepted engineering principle that material used in laminated form is more resilient than a single layer of identical material. While considering how construction engineers often used a laminating technique to reinforce load-bearing wooden beams in the ceilings of buildings, it occurred to me that a similar technique could be adapted to resolve the twisting tendency I had encountered in the augmentation of saddle depressions using lyophilized homograph rib cartilage.

METHODS

I approached Bone SA, a donor-cartilage bank in Johannesburg, South Africa, and requested them to supply me with preshaped cartilage strips of varying thickness (Bone SA tests all donor rib cartilage grafting material [harvested from "brain dead" donors, with permission] for contagious diseases prior to the lyophilizing process). While experimenting, I discovered that 2-mm-thick strips provided me with cartilage layers pliable enough to trim and shape and then suture into a lamination suitably shaped and sized for the intended augmentation. Thicker strips tended to reintroduce the inherent tendency of the graft to resume its original curved shape, much to the detriment of the desired result.

To facilitate uniformity in the preparation of each lamination, I designed and developed a set of templates from soft-solid silicone that could be used in various combinations. Each silicone set consisted of 2 to 3 individual sizers of varying width and length (**Figure 1**A). Using a "mix and match" process, like shuffling pieces of a jigsaw puzzle, I layered the sizers in various size and length combinations to determine the size and the number of strips for each individual lamination (Figure 1B). This became a standard procedure to determine the correct shape and dimension for each augmentation. Satisfied with the vastly improved results obtained from laminations, I discontinued using monounit cartilage beam grafts at the beginning of 2003, thereafter using laminated beam cartilage grafts exclusively for saddle depression procedures.

SURGICAL TECHNIQUE

I commenced an operation for dorsal depressions using the "open" approach, raising the skin–soft tissue envelope (S-STE) to the level of the radix. With a retractor and Joseph scissors, I "skeletonize" the S-STE envelope

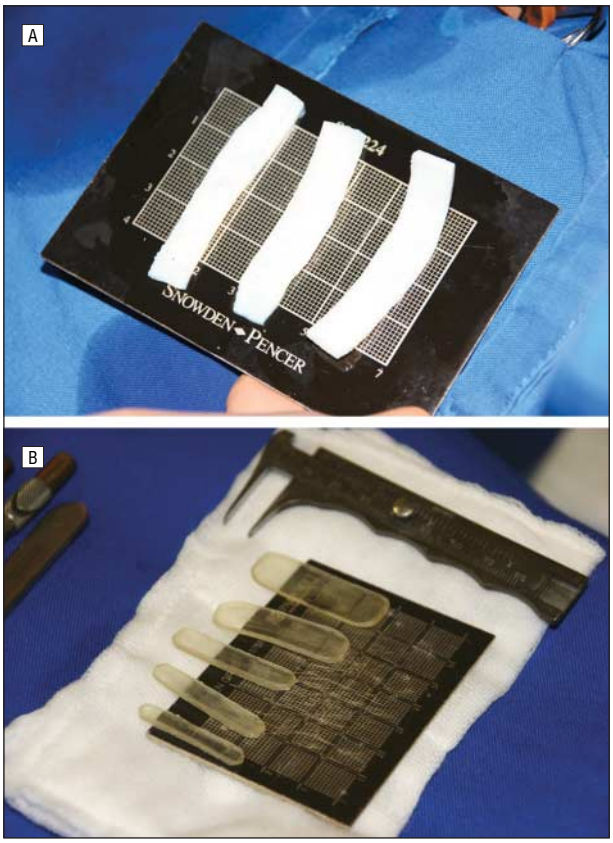

Figure 1. A, Two-millimeter strips of precut rib cartilage; B, soft solid silicone sizers layered in various size and length combinations.

over the dorsal depression in preparation for the augmentation; this also later minimizes tension on the overlying skin of the soft tissue envelope. With a rasp, I level and roughen the base of the depression to create a level foundation for the lamination. Then, using an assortment of silicone sizers, I measure and calculate the number of layers I will need to create a suitable lamination for the augmentation of the depression.

I insert the sizers under the S-STE envelope into the dorsal depression (exposed by lifting the S-STE) until the dorsal profile conforms to the desired new shape of the nose. Having determined the required number of cartilage strips and working with each layer, separately and in a sequence from the largest to the smallest sizer, I position and clamp each sizer over a 2-mm-thick strip of precut rib cartilage on a sterilized, nonslip, wooden tongue spatula with a Cottle clamp.

Guided by the outline of the sizer, I trim the cartilage into shape with a No. 15 blade scalpel, repeating the trimming process with each successive sizer (**Figure 2**A). Each cartilage strip so treated conforms to a corresponding sizer (Figure 2B). Having cut the required number of laminations, I place the cartilage strips in layers, on top of each other (taking care to place them in positions that oppose and cancel the natural curvature of each layer) (Figure 2C), and suture them into position with 4-0 monofilament polypropylene (Deklene; Genzyme Corp, Cambridge, Massachusetts) (Figure 2D).

Prior to sliding the lamination under the S-STE, I carefully bevel the edges of the top lamination to pre-

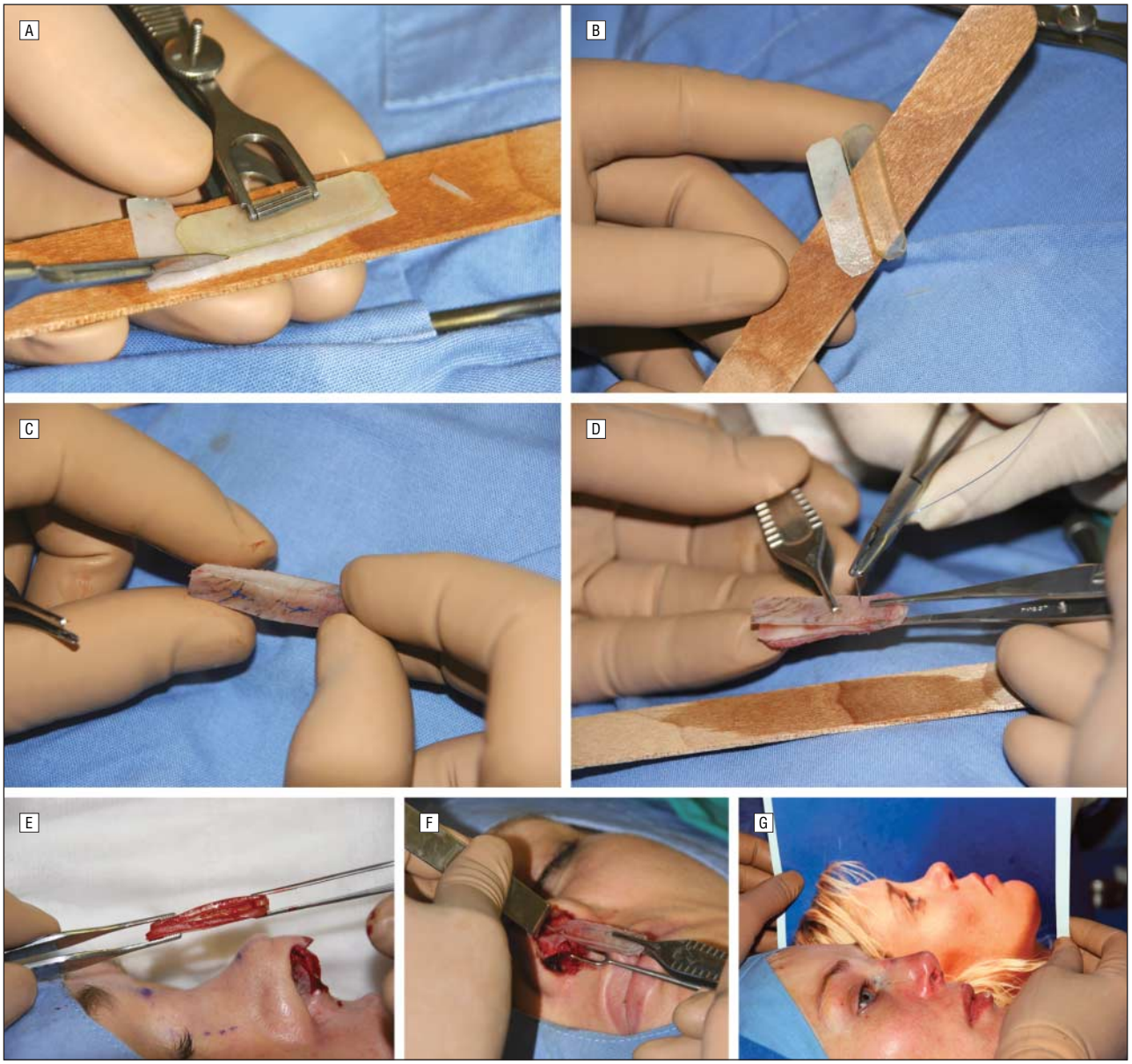

Figure 2. A, Trim the cartilage into shape with a No. 15 blade scalpel; B, each cartilage strip conforms to a corresponding sizer; C, place the cartilage strips in layers, on top of each other; D, suture into position with 4-0 monofilament polypropylene (Deklene; Genzyme Corp, Cambridge, Massachusetts); E, bevel the edges of the top lamination, to prevent the edges of the graft from curling or deforming; F, slide the lamination under the skin–soft tissue envelope, placing the knot away from overlying skin; G, compare the tentative result against the patient's preoperative preview photograph.

vent the edges of the graft from curling or deforming (Figure 2E). I also sometimes cover the graft with a thin layer of Alloderm (LifeCell Corp, Branchburg, New Jersey) or lyophilized perichondrium to soften the outline of the lamination, positioning the suture knot on the undersurface of the lamination away from the overlying skin (Figure 2F). At this stage, before closing the nose, I compare the tentative result against the patient's preoperative preview photograph (a digital image taken with Mirror Simulation software [Canfield Scientific Inc, Fairfield, New Jersey]) (Figure 2G). The result invariably corresponds to the soft silicone sizer template. Surgery is concluded in the normal manner by closing the transcolumella incision with 6-0 fast absorbing plain cat gut sutures.

RESULTS

The results (117 dorsal beam procedures from 2003 through 2005) documented with medical case history follow-ups and postoperative imagery show that the laminations do not bend or revert to the original shape of the rib. The lyophilized rib cartilage lamination, forming a "host" grid for the growth of new tissue, revascularizes as does the usual grafting material. Laminated lyophilized rib cartilage, which does not undergo irradiation, has not shown any resorption tendencies. All cases documented thus far (4 years since the adoption of the laminated technique) meet and conform to the patient's preoperative expectations prior to the procedure (**Figure 3**).

Figure 3. Preoperative (A, C, E, G, and I) and postoperative (B, D, F, H, and J) results of the laminated dorsal beam graft procedure.

COMMENT

Having used the laminated dorsal beam graft procedure without any evident manifestation of adverse postoperative distortions for 4 years (since 2003), I believe that the technique has resolved the inherent tendency of thick, single monounits to distort during the postoperative recovery period. I now use laminations for all revision rhinoplasty operations in which there is a deficiency of the central, septal support system. I also use precut cartilage strips for tip shield grafts, spreader grafts, lateral crural strut grafts, medial crural strut grafts, and caudal septal extension grafts. Being long and thin, the 2-mm-thick strips are particularly convenient for shield grafts. I specifically use the technique for correcting saddle nose depressions in white, Asian, and African noses.

Figure 4. Sutured 2-mm-thick laminated strips of donor rib cartilage counteract the natural tendency of monounits to bend and twist.

In conclusion, sutured 2-mm-thick laminated strips of donor rib cartilage counteract the natural tendency of monounits to bend and twist (**Figure 4**). For these procedures and all others undertaken at my private clinic in Pretoria, South Africa, I use conscious sedation and regional sensory nerve block anesthesia.

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Additional Information: Mr Fysh is a professional writer with a 7-year-long association with Dr Swanepoel on medically related writing topics.