The “Loop with Anchor” Technique to Repair Mitral Valve Prolapse

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Fig. 1  The preoperative preparation. (A) A small loop is formed from CV-4 Gore-tex sutures. (B) The small loop is affixed to a pledget. (C) A loop is formed by using a slide caliper. (D) The tying of the five loops. (E) The finished artificial chord made of CV-5 Gore-tex sutures.

Fig. 2  (A) The papillary muscle is exposed with a malleable retractor. (B) The anchor component is affixed to the papillary muscle. (C) The length from the small loop (at the anchor component) to the retracted healthy posterior leaflet is measured by using nerve hooks and right angle forceps. (D) The loop component of the artificial chord is affixed to the anchor component. (E) A handmade knot pusher is used to tie.
After the anchor component is affixed to the papillary muscle, the distance from the 2-mm small loop to the coaptation point on the healthy leaflet is measured. The size of the loop component is then determined (Fig. 2C).

An artificial chord of CV-5 Gore-tex suture is passed through the 2-mm small loop and tied (Fig. 2D). Tying is somewhat deep and a handmade knot pusher (Daiso Industrial Co. Ltd., Hiroshima, Japan), which is made of a funnel, is used (Figs. 2E, 3A and 3B). Each loop of the artificial chord is affixed to the mitral leaflet with another CV-5 Gore-tex suture (Fig. 4).

The competence of the mitral valve is checked by a saline infusion into the left ventricle. After the hydrostatic test, additional maneuvers can be performed. If all of the artificial chordae lengths need to be changed, the artificial chord is cut at the 2-mm small loop at the anchor, and another artificial chord with loops is applied. If the lengths of some of the loops need to be shortened, a surgeon can affix additional CV-5 Gore-tex sutures to the mitral leaflet without cutting the previous fixation (Fig. 4). If the chords need to be lengthened, then the surgeon can cut the previous fixation and add another stitch.

Results

We successfully treated two patients. One patient was a 66-year-old male and the other, a 61-year-old male. In both patients, the mitral lesion was an A2–A3 prolapse. Four loops were used in one patient and five loops were used in the other patient. In the first patient, there was no additional maneuver used for mitral plasty. In the second patient, the height of A2 remained slightly high after initially affixing the loops at the mitral leaflet. One loop at A2 was affixed again, thereby shortening the chord length without cutting the first fixed suture (Fig. 4). Other surgeries performed for the patients were a tricuspid valve plasty in the first patient and repair of a patent foramen ovale in the second patient.
In the first and the second patient, the cardiopulmonary bypass time was 161 minutes and 139 minutes, respectively, and the aortic cross clamp time was 131 minutes and 105 minutes, respectively. At discharge, there was no mitral regurgitation in the first patient and trivial regurgitation in the second patient. The follow up periods were 19 months in the first patient and two months in the second patient. Both patients are in good condition.

Discussion

An artificial chord composed of expanded polytetrafluoroethylene sutures has successfully replaced mitral valve chordae tendineae.1,2) However, there are some technical difficulties that can diminish the surgical results. Slippery knot tying of the artificial chord sometimes causes the final chordae length to be shorter or longer than expected, and a surgeon consequently needs to redo the procedure. Surgeons have developed several approaches for precise tying and avoidance of knot sliding. However, the technical difficulty of these approaches sometimes hinders the reproducibility of the procedure.3) The loop technique somewhat solves the problem of slippery knot tying.4) Precisely measuring the chordae tendineae is rather difficult since the geometry of the left ventricle at the time of measurement differs from its geometry during the hydrostatic test or during a heart contraction.5) If the hydrostatic test indicates that all of the artificial chordae tendineae should be changed, changing them with the loop technique is time consuming.

We, therefore, developed a technique that allows us to change the chordae length at two points after the hydrostatic test. The technique consists of three basic components. The first component is the “anchor” (which is the papillary component with a small loop); the second component is the “loop” (which is an artificial chord that has several loops and one root); and the third component is the “loop tip suture” that affix the loops to the mitral leaflet. A surgeon can change the loop component if the chordae length needs a major change or re-suture a loop to the mitral leaflet if the needed change is minor. Further observation might be needed whether the interference between the first and the next “loop tip suture” affects valve coaptation.

Conclusion

Our loop with anchor technique eliminates the problem of slippery knot tying and, after the hydrostatic test, allows a surgeon to adjust the chord length with minimal effort. Despite the limited number of patients and the need for further follow-up, the technical ease of this technique may prove to be reproducible.

References