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A mitral valve repair update: simple, intuitive and physiological techniques, using running sutures (part I)

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Abstract

Today's mitral valve techniques are pluralistic, and the result of variable contributions over decades. However, they are often associated with subjectivity, and inter-surgeon variability, as well as differing outcomes. Here, we propose a set of conceptual techniques, which aim to simplify and standardize mitral valve repair, of which some we have already verified in practice.

Keywords: Mitral valve repair • Mitral valve regurgitation • Surgical techniques

INTRODUCTION

Modern mitral valve repair techniques [1–3], albeit comprehensive and validated, may not be entirely objective, allow space for speculation on where to pass the neo-cords and may leave out fine nuances of the pathology, such as asymmetry of the neighbouring scallops, clefts or incisures or commissural lesions. As in the management of any complex system, variability impedes performance and outcome, so in mitral valve repair, variability may impact the result both positively, but also negatively. Also, each surgeon may walk out with a different degree of residual regurgitation, despite same pathology.

I would like to propose a set of new techniques, which employ a running suture, rather than individual cords, through the pathological leaflet margin, and involve the papillary muscle, and/or the annulus. They follow standard landmarks, such as papillary muscle tips, free leaflet edge running and commissure, so that little space for guessing is left. They could attenuate variability between surgeons and methodologies. The techniques introduced here are often simple to implement and require less repair tools and materials, as cords.

In the following illustrations, we demonstrate and describe the surgical steps (Figures 1 and 2).

DISCUSSION

We propose a set of mitral valve repair techniques, which may render the procedure more intuitive and objective. Of note, some of the proposed techniques are verified, as cases ($n = 8$) appear in our practice, while validation—in stringent regulatory terms—is awaited to be established following eventual wider adoption and long-term follow-ups. Some remain conceptual at this stage while awaiting cases to implement them.

They reduce guessing on the length and position, as well as number of neo-cords, and address combined pathologies of the mitral valve apparatus, or different components of the one and same condition (annulus, papillary muscles and leaflet segments). This is due to standard anatomical landmarks and the combination with a running suture. Also, we wish to clarify that leaflet motion is not compromised using our methods, both in concept as well as when verified. We argue that our proposed techniques may simplify and standardize mitral valve repair and may enhance adoption by even surgeons with average experience in the mitral valve domain. For reference, a further non-resectional technique has been reported by Agnino *et al.* [4, 5].

We are not a huge volume centre of MV repair. In the early 8 cases performed, of which a few were video-recorded, the immediate echocardiographic outcome was invariably excellent, with only trace or zero residual regurgitation. We have performed 4 'Roman Arches', 2 'Crescents', 1 'Argo' (which we had to go back on pump for revision due to a surgical error in the fixation of the exit knot at the postero-medial commissure) and 1 Roman V for A2–P2 prolapse. Wherever videos are available, we share them as part of our paper sequence here (parts I: Videos embedded in this paper, showing the "Roman Arch" technique for anterior (Video 1) and posterior (Video 2) leaflets. Not all techniques were

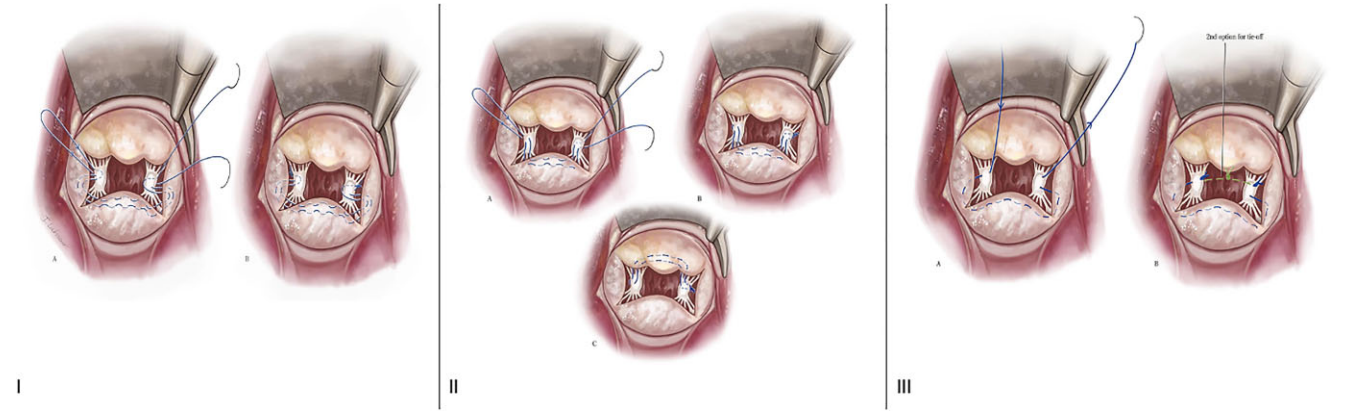


Figure 1: (**I**) The 'Crescent' technique (PM–P1–P2–P3–PM running suture). A neocord is passed starting from the anterior side of the antero-lateral papillary muscle (PM), then ascends to the P1, passes through the P2–P3 margin and then descends to the postero-medial PM. Good for multiple leaflet prolapse or Barlow's. Good for segmental asymmetry and clefts. Do not use if P1 or P3 is normal. (**II**) The 'Roman Arch' technique (PM–P2–PM running suture). The most frequent situation we are facing is a singular segmental prolapse, such as P2 or A2. A neocord is passed through the antero-lateral PM, ascends to the P2, passes through the margin of the P2 and descends and exits through the postero-medial PM. This is to address large redundant P2. Similarly, good for lengthy A2 prolapse. The easiest, yet very reproducible technique, best used for isolated P2 or A2 prolapse of any length. Do not use for limited, localized prolapse of part of the scallop only, when PMs are far apart. (**III**) The 'Closed Omega (Ω)' technique (PM–P1–P2–P3–PM running suture with PM approximation). This suture will take care of the asymmetrically large, prolapsing P2, and also approximate the dents or clefts between P1 and P2, P2 and P3; hence, the prolapse is gone, the indentations are controlled and the height of the posterior leaflet is uniform (and/or papillary muscles approximated). Do not use if PMs are very frail and feature multiple heads (risk of suture cut-through).

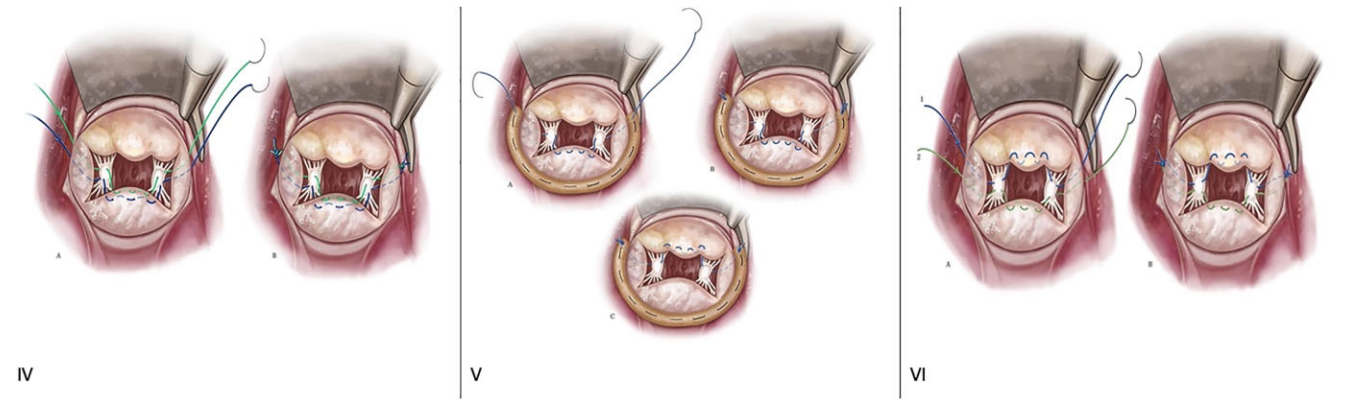
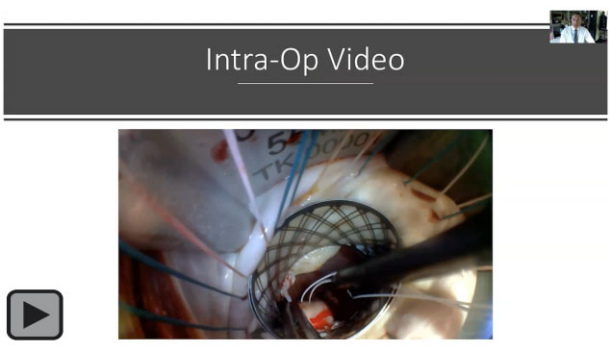


Figure 2: (**IV**) The 'Longhorn' technique (C–PM–P2–PM–C running suture). Concurrent trans-annular plication and posterior or anterior leaflet reduction. Here, the neocord needle enters through the antero-lateral commissure, descends to the antero-lateral PM, ascends and passes through the margin of the prolapsing P2, then descends to the postero-medial PM, then ascends back to the postero-medial commissure, and exits the annulus towards the atrium. Provides partial annular plication, through traction on commissures. Do not use in severe scallop asymmetry in P1 and P3. (**V**) The 'ARGO' technique (ring–C–PM–P2–PM–C–ring running suture). The neocord needle passes through the annulus at the antero-lateral commissure (with or without annuloplasty ring passage), then descends to the antero-lateral PM, then ascends through the margin of the prolapsing P1, or P2, or P3 segments, then descends through the postero-medial PM, and then exits through the postero-medial commissure through the annulus and/or annuloplasty ring. Do not use in severe scallop asymmetry of P1 and P3. (**VI**) The 'Nessie' technique (double running suture, as above: C–PM–P2–PM–C). The neocord enters through the antero-lateral commissural annulus, passes through antero-lateral PM, then various segments and then postero-medial PM and then exits through postero-medial commissural annulus. Good for multiple prolapses, symmetric, annular ectasia and 3D hypermotility of the valve apparatus, such as in Barlow's and other pathologies, with annular dilatation and dysfunction. A 'one-strategy solution' for a multi-segment Barlow's pathology, when only limited resection is performed. Controls the need for countless cords for an extensive Barlow's.



Video 1: The 'Roman Arch' Technique for the anterior mitral valve leaflet.

Video 2: The 'Roman Arch' Technique for the posterior mitral valve leaflet.

attempted yet, but it is critical for us to offer a first concept disclosure to the audience.

Our techniques are proposed as an evolution (not revolution) in the field and may help surgeons adopt and perform solid repairs, in both the open as well as endoscopic setup, and reduce repair failures, even in the hands of less-experienced surgeons.

In conclusion, we propose and partially verify a set of intuitive methods of mitral valve repair, which utilize less cords, eliminate variability to some extent and may facilitate reproducible repair with lesser effort, while addressing multiple pathologies, at the discretion of the surgeon.

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Conflict of interest: none declared.

Data Availability Statement

The Author verifies availability of data and videos for the described techniques, two of which are embedded for viewing through QR code links in this article.

Reviewer information

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