

Cross Compression Suture: A Modification of the Hayman Suture for Uniform Uterine Compression in Postpartum Hemorrhage

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Abstract—Background: Uterine compression sutures are an established fertility-preserving surgical intervention for atonic postpartum hemorrhage (PPH). The Hayman suture, while simple and effective, is associated with mechanical limitations including uterine compartmentalization and non-uniform compression, which may contribute to delayed uterine recovery, ischemic injury, and intracavitory collections.

Objective: To describe and theoretically evaluate a modification of the Hayman suture—the Cross Compression Suture (CCS)—designed to provide uniform, centripetal uterine compression while minimizing compartmentalization and focal ischemia.

Design: Concept paper

Conclusion: The Cross Compression Suture is a simple, reproducible modification based on biomechanical principles of force redistribution. It has the potential to improve physiological uterine compression with reduced morbidity. Clinical validation is warranted.

I. INTRODUCTION

Postpartum hemorrhage remains a leading cause of maternal morbidity and mortality globally. When pharmacological measures fail to control uterine atony, surgical techniques aimed at preserving the uterus are employed. Among these, uterine compression sutures have gained widespread acceptance due to their rapid application and effectiveness.

The Hayman suture is particularly favored because it can be applied quickly. Despite these advantages, emerging clinical experience suggests that certain mechanical characteristics of the Hayman suture may predispose to suboptimal uterine recovery and localized complications.

This paper introduces a modification—the Cross Compression Suture—designed to address these

limitations through improved force distribution and preservation of uterine cavity integrity.

II. LIMITATIONS OF THE CONVENTIONAL HAYMAN SUTURE

Although effective, the Hayman suture exhibits inherent mechanical drawbacks:

1. Compartmentalization of the Uterine Cavity
Parallel vertical compression sutures may divide the uterine cavity into functional compartments, impairing physiological drainage of blood and lochia.

2. Non-Uniform Compression
Compression forces are concentrated along the suture tracts, leaving intervening myometrial areas relatively under-compressed.

3. Clinical Consequences
These mechanical effects may lead to:
o Slower uterine involution and recovery
o Localized myometrial ischemia or necrosis
o Hematometra or intrauterine collections
These observations formed the basis for developing a modified compression strategy.

Rationale for the Cross Compression Suture

An ideal uterine compression suture should:

- Provide uniform compression across the uterine corpus
- Avoid partitioning of the uterine cavity
- Preserve global myometrial perfusion
- Allow physiological uterine drainage

The Cross Compression Suture was conceptualized to meet these criteria by altering the direction and interaction of compressive force vectors.

III. DESCRIPTION OF THE CROSS-COMPRESSION SUTURE TECHNIQUE

Suture Material

- Catgut No. 2 (absorbable)

Surgical Technique

1. Right Uterine Angle Bite

A full-thickness bite is taken from the anterior to posterior uterine wall at the right uterine angle. The suture is not immediately tied, creating a loop with two free ends.

2. Left Uterine Angle Bite

An identical anterior-to-posterior full-thickness bite is taken at the left uterine angle, again forming a loop with two free ends.

3. Cross Knotting

The free ends from the right and left loops are brought across the uterine fundus and tied **in a criss-cross fashion**, producing intersecting compression vectors. Right anterior free end is tied to the left posterior free end and left anterior free end is tied to right posterior free end making a criss cross OR a shape of X on the fundus

4. Final Configuration

The crossed sutures exert uniform centripetal compression over the uterine body without forming longitudinal compression columns.

IV. THEORETICAL BASIS AND BIOMECHANICS OF THE CROSS-COMPRESSION SUTURE

Force Vector Distribution

The hemostatic efficacy of uterine compression sutures is determined not only by tension but also by the direction and dispersion of compressive forces. Conventional Hayman sutures generate predominantly vertical compression vectors, resulting in localized high-pressure zones along suture tracts.

In contrast, the Cross Compression Suture creates intersecting oblique vectors across the uterine corpus. When the bilateral loops are tied in a cross fashion, forces are redistributed symmetrically toward the center of the uterus, resulting in homogeneous compression of the anterior, posterior, and lateral myometrial walls.

Prevention of Uterine Compartmentalization

From a biomechanical standpoint, parallel vertical sutures act as rigid compression columns that may

divide the uterus into semi-isolated compartments. The crossed configuration of the proposed technique avoids longitudinal partitioning, thereby preserving a single functional uterine cavity and facilitating physiological drainage.

Myometrial Perfusion and Ischemia Risk

Focal over-compression is a known contributor to tissue ischemia. By dispersing compressive stress over a broader surface area, the Cross Compression Suture theoretically reduces peak pressure points. This may lower the risk of localized uterine wall necrosis while maintaining adequate overall compression for hemostasis.

Temporal Load Reduction and Suture Material

The use of absorbable Catgut No. 2 aligns with the biomechanical requirement for temporary uterine support. Progressive loss of tensile strength parallels uterine involution, allowing gradual reduction in compressive load and minimizing prolonged mechanical stress on the myometrium.

Proposed Advantages of the Cross Compression Suture

Parameter	Hayman Suture	Cross Compression Suture
Compression pattern	Vertical, segmental	Uniform, centripetal
Uterine cavity	Compartmentalized	Single functional cavity
Force distribution	Non-uniform	Homogeneous
Ischemia risk	Relatively higher	Theoretically reduced
Lochial drainage	May be impaired	Likely preserved
Technical complexity	Simple	Slightly elaborate

V. DISCUSSION

The Cross Compression Suture represents a logical evolution of existing uterine compression techniques. By modifying the geometry of force application rather than increasing tension or complexity, this technique

addresses fundamental mechanical limitations inherent in vertical compression sutures.

The concept emphasizes physiological compression—adequate to control hemorrhage while respecting uterine anatomy, perfusion, and drainage. As a conceptual innovation, its strength lies in biomechanical plausibility and surgical simplicity.

VI. LIMITATIONS

- Conceptual and technical description without clinical outcome data
- No comparative trials with existing compression sutures
- Long-term reproductive and menstrual outcomes not yet evaluated

VII. CONCLUSION

The Cross Compression Suture is a novel, conceptually sound modification of the Hayman suture designed to provide uniform uterine compression without compartmentalization. Grounded in biomechanical principles, it may reduce ischemic complications and promote faster uterine recovery. Prospective clinical evaluation is required to establish safety, efficacy, and long-term outcomes