

Symposium II

Arthroscopic rotator cuff repair: Double row technique

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고 상 훈

Rotator cuff tear

1. Most common cause of chronic shoulder pain
2. Rotator cuff disease

초기: 건염과 활액 낭염으로 시작하여 통증을 일으키고

진행: 힘줄이 약해져서 실밥이 풀어지듯이 회전근 개 파열 발생

Rotator cuff disease

Stage 2 impingement, Tendonitis, fibrosis, Partial-thickness tears, Full-thickness tears : complete cuff tears, Irreparable tears Cuff arthropathy

Arthroscopic repair

Advantage of arthroscopic repair

Smaller incisions: cosmetic, Access to the G-H joint for inspection

Treatment of intra-articular lesions, No need for detachment of the deltoid, Less soft tissue dissection, Less pain, More rapid rehabilitation

Consideration at arthroscopic repair

Patient age, Patient activity level, Concomitant lesion, Range of motion, Symptom, Tear location

Advantage of single row repair

Relative simple technique than double row technique, not technical difficulty of performing double row

No time consumption than double row

No high cost than double row: additional anchor not needed

No potential expense of vascularity

Disadvantage of single row repair

Warner, Iannotti, Flatow Complex and Revision Problems in Shoulder Surgery 2nd edition

High rate of re-tear, Anchor failure, Suture loosening, Less superior compression of torn cuff after rotator cuff repair, Not re-establishing normal footprint, Tendon failure after simple stitch: need to modified Masson Allen suture

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Integrity after arthroscopic repair

Galatz, Yamaguchi et al, JBJS-A 2004

Outcome and repair integrity, Complete arthroscopic repair, Large and massive tear, Arthroscopic repair : high re-tear, Above 90%

Mode of failure for rotator cuff repair

Mode of failure for repair with suture anchors identified at revision surgery prospectively followed 342 consecutive torn rotator cuff

re-tear rate: 25%~90%

most common: tendon pulling through sutures

than tear in new location & anchor pulling out of bone

weak link in rotator cuff repairs with suture anchors: tendon-suture interface

Technique for arthroscopic cuff repair

Simple arthroscopic repair, Double row footprint repair

Apreleva & Warner et al, 2002

Waltrip & Andrews et al, 2003

Lo & Burkhart 2003

De Beer et al 2002

Transosseous equivalent repair

Millett et al 2004: Mattress double anchor, footprint repair

ElAttrache, Tibone et al, J Shoulder Elbow Surgery 2007: Suture bridge using push lock

Reinforced cuff repair

Modified Mason-Allen stitch, Arthroscopic Mac stitch, MacGillivray and Ma 2004, Ma et al, JBJS-A 2006

Anatomical footprint reconstruction

- Biomechanical study -

Apreleva & Warner et al, 2002 Arthroscopy

Single row with SAS(suture anchor simple)--> covered 67% original SS insertion

More lateral anchor placement -->increase repair-site area

Large contact area btw tendon and bone -->improve biological healing

Waltrip & Andrews et al, 2003 AJSM

Initial fixation strength of double layer repair : exceed single layer repairs

Either suture anchor or trans-osseous tunnel

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Double row rotator cuff repair

Lo & Burkhart 2003 Arthroscopy

Medial row : just lateral to articular surface of head

Lateral row : just medial to drop-off of GT

May potentially improve strength and healing of rotator cuff repair constructs

Double row rotator cuff repair

De Beer et al 2002

58 cases by footprint reconstruction

90% excellent and good results

89% intact cuff shown by ultrasound

Our Double row rotator cuff repair

Double row repair

Double row repair

Mazzocca, Millett et al. AJSM 2005

Single row similar to double-row in load to failure, cyclic displacement, gap formation

Double-row larger footprint than single-row

Fealy, Warren et al. Arthroscopy 2006

No differences in strength at 2-anchor and 4-anchor repair

Park JY et al. KJSES 2006

No difference on small & medium tear

Significant abduction strength on large tear



Fig. 1. Double row suture anchor repair

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Technique of double row repair

Place medial row suture anchor, Place suture 15mm from cuff margin, Place lateral row anchors, Pass lateral row suture 10 mm from cuff margin, Lateral suture as simple suture loop, Secure suture limbs of medial anchors, completion of medial row repair, Tie and secure medial row suture

Transosseous tunnel cuff repair

Apreleva, Warner et al. Arthroscopy 2002

3-dimensional (3-D) reconstruction: area of original supraspinatus insertion, repair-site area after 4 recon method

TOS (Transosseous simple): 20% larger repair-site area than

TOM (transosseous mattress suture)

SAS (suture-anchor simple suture)

SAM (suture-anchor mattress suture)

TOS repair :

better potential for healing

ultimately, greater strength of repair

Maxwell Park, Louis U. Bigliani et al. AJSM 2005

transosseous tunnel repair : more contact and greater pressure distribution for suture anchor

Mattress double anchor footprint repair

Similar to transosseous techniques: Novel arthroscopic cuff repair

use of 2 suture anchors independently --> connected by suture loop

Suture linked between 2 bio anchors

distributes the stress across 2 anchors

restores a large surface area for healing between the rotator cuff and the tuberosity

Mattress double anchor

Alternative suture configuration with interlocking of the sutures, To prevent cutout from the tendon

Sutures criss-cross from 4 separate anchors, Interlocked, Maximize tendon compression,

Maximize repair surface area

Suture bridges using push lock

Transosseous equivalent rotator cuff repair

6 fresh-frozen human shoulders

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4 suture bridges:

medial 2 anchors

lateral interference screw

Suture limb bridge over tendon

Results

Improve contact area : nearly twice more than double-row (77.6% vs 39.6%)

Improve pressure area : 30% more than double-row repair

Transosseous-equivalent repair

4 suture bridges and 2 Bio-Tenodesis screws

medial & lateral fixation points : same as traditional open transosseous technique

medial row suture limbs : not cut after tying

Lateral row :

two 4.5-mm holes : 1 cm distal to the lateral edge of the footprint

in line with the medial suture anchors

distanced 12.5 mm apart in the anterior-posterior direction

cannulated bio-Tenodesis 5.5-mm screw

suture limb from each medial suture anchor :

minimum 4 kg of tension

bio-tenodesis screw : 45° angle

screw countersunk 1 mm

each suture limb tied to a limb from the loop previously passed

2 knots tied over bio-Tenodesis screw

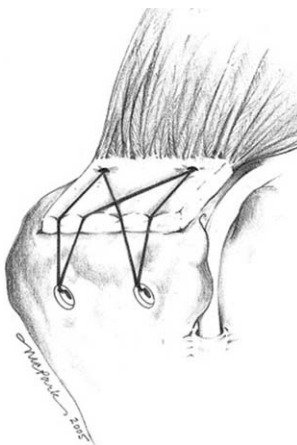


Fig. 2. Transosseous-equivalent repair

Transosseous-equivalent repair

2 suture bridges and 1 bio-tenodesis screw, similar to the 4-suture bridge technique

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except only 1 Bio-Tenodesis screw, 1 cm distal to the lateral edge of the footprint
 each medial anchor : 1 remaining suture limb



Fig. 3.

Biomechanics of transosseous-equivalent

Mean ultimate load to failure : greater to double-row

Gap formation : not different to double-row

Stiffness : not statistically different

Advantage transosseous-equivalent repair

Diagrams of Reinforced Technique

Arthroscopic Mason-Allen stitch

Scheibel, Habermeyer Arthroscopy 2003

Arthroscopic Mason-Allen stitch reported

MacGillivray et al. Arthroscopy 2004

Tendon-suture interface : weak link in arthroscopic rotator cuff repair

Simply arthroscopic modification of modified Mason-Allen stitch

Separation & Combination at the site of repair as a

horizontal mattress loop

vertical simple loop

Massive Cuff Stitch

Ma et al. JBJS-A 2004

Biomechanical study using sheep infraspinatus, MCS : increase the strength of tendon-suture interface, Horizontal mattress loop act as checkrein for vertical simple loop, To prevent suture pull-out through tendon, Ultimate tensile strength, Three times than

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simple suture repair, Similar than open modified Mason–Allen stitch
MCS combined with Two row, Biomechanical study
Massive Cuff Stitch, Similar cyclic loading & load to failure than double row fixation

New reinforced stitch

Castagna et al, Chir Organi Mov 2005 New reinforced stitch simple stitch with horizontal stitch
Resistance to loading similar to modified Mason–Allen
greater than simple and mattress stitch
Baleani et al, Clin Biomech 2006
No difference in two ‘reinforced’ stitches
simple stitch closed over horizontal loop
modified Mason–Allen
maximum grasping power : only using with high–strength suture material
Simple stitch closed over horizontal loop
attractive alternative for arthroscopic repair than to modified Mason–Allen for open repair