ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

King Chulalongkorn Memorial Hospital
The Thai Red Cross Society

EFFECTIVENESS OF INTRAOPERATIVE GLENOHUMERAL JOINT INJECTION OF HYALURONATE/CARBOXYMETHYL CELLULOSE IN ARTHROSCOPIC ROTATOR CUFF REPAIR

Supanut Klaiudom, M.D.
Thun Itthipanichpong, M.D.
Thanathep Tanpowpong, M.D.
Danaithep Limsakul, M.D.

Sports Medicine Unit
Department of Orthopaedics
King Chulalongkorn Memorial Hospital, Thailand

Faculty Disclosure

- Nothing to disclosure.

Background & Rationale

- Arthroscopic Rotator cuff repair surgery generally have good clinical outcome.

- Shoulder stiffness is the most common complication and can lead to poor clinical outcomes and patient discomfort.

- A large numbers of anti-adhesive agents have been used experimentally and clinically to prevent postoperative adhesions. Most commonly used agents : Hyaluronic acid (HA), considered anti-adhesive agent, plays a critical role in controlling the inflammatory process and minimizing pain.
  - *Since HA has low half-life*, it's frequently used with other substance which acts as a barrier, such as Carboxymethyl-cellulose (CMC)

Carboxymethyl-cellulose (CMC)

- A Plant-based derivatives (Cellulose) ; first synthesized in 1918 (Germany).
- Widely used in various fields such as food, textile, pharmaceutical industries, and tissue engineering.
- Used as an anti-adhesive agents in medical use as an adhesion barrier.
- Multiple studies have been reported that CMC has no cell toxicity or evidence of chondrocyte damage and proved to be biological safety.

Interesting characteristics

- Mechanical strength
- Formability
- Hydrophilicity
- Viscosity

Background & Rationale

- In this research, we investigated the **postoperative outcomes** of intra-operative glenohuemeral joint injection of **HA/CMC** in patients who underwent arthroscopic rotator cuff repair.

Research Question :

Does intraoperative glenohumeral HA/CMC injection can improve postoperative shoulder stiffness after arthroscopic rotator cuff repair ?

Study Design

- Double-blinded, single-center, randomized controlled trial.
- Randomized patients into experimental and control group using block randomization
  - The experimental group received HA/CMC injection.
  - The control group received normal saline injection.
- Sample size calculation : **N = 90** (HA/CMC injection group = 45 / Normal saine (control) = 45).
- Inclusion criteria :
  - **Patients with small to medium size rotator cuff tear**
    (DeOrio & Cofield classification)
- Exclusion criteria :
  - History of shoulder surgery
  - Shoulder instability
  - Rheumatoid arthritis
  - Underwent open rotator cuff repair
  - History of shoulder joint infection
- Enrollment : Patients with small to medium size rotator cuff tear who underwent arthroscopic rotator cuff repair at KCMH between August 2022 and May 2023.
- Primary outcome : Clinical parameters of patients with rotator cuff tear who underwent arthroscopic rotator cuff repair of control & experimental group at **6 months post-operation.**
- Secondary outcomes : Clinical parameters and postoperative ROMs of shoulder of patients with rotator cuff tear who underwent arthroscopic rotator cuff repair of control & experimental group at 6 weeks, 3 months, 6 months, 1 year post-operation.

Surgical Procedure

- All surgeries were performed by sports medicine orthopedists at King Chulalongkorn Memorial Hospital. (KCMH)
- **Glenohumeral examination**
  - Tenodesis/Tenotomy as indicated.
- **Subacromial space exploration**
  - Acromioplasty was selectively performed in cases with a lateral projecting spur.
- Standardized rotator cuff repair techniques were applied in all cases.
- **HA/CMC agent** (5 ml) was injected into glenohumeral joint just before skin closure in experimental group. Normal saline was injected in control group in the same amount and manner.

Data Collection & Analysis

- Collect preoperative & postoperative outcomes between controlled and experimental group.

Preop
- Demographics
- Constant score
- ASES score
- VAS
- ROM

6 wk F/U
- Constant score
- ASES score
- VAS
- ROM

3 mo F/U
- Constant score
- ASES score
- VAS
- ROM

6 mo F/U
- Constant score
- ASES score
- VAS
- ROM

1 yr F/U
- Constant score
- ASES score
- VAS
- ROM

- Demographics
  - Categorical data : Chi-square test
  - Continuous data : Mean

- **Results**
  - Continuous data : **Unpaired T-test**
  - Among group in different time point of assessments : **Repeated measured ANOVA**
  - Statistically significant with P-value < 0.05

Demographic data

	HA/CMC injection group (N=45)	Control group (N=45)	P value
Age (Mean, yrs)	64.60	64.95	0.568
Sex (M/F)	12 / 33	8 / 37	0.310
Operation side (Rt/Lt)	30 / 15	37 / 8	0.091
Tear size	1.56	1.60	0.664

Results

Funtional score	HA/CMC injection group	Control group	P value
Constant score			
Preop	53.16	55.64	0.45
6 wk postop	58.75	51.86	0.04
3 mo postop	67.60	70.71	0.10
6 mo postop	75.22	76.55	0.52
1 yr postop	78.08	79.73	0.40

Funtional score	HA/CMC injection group	Control group	P value
ASES score			
Preop	61.57	59.83	0.62
6 wk postop	62.19	59.83	0.45
3 mo postop	73.60	72.84	0.40
6 mo postop	80.84	75.37	0.03
1 yr postop	83.40	78.63	0.08

Results

Funtional score	HA/CMC injection group	Control group	P value
Visual analog scale			
Preop	3.44	3.35	0.45
6 wk postop	1.55	1.62	0.39
3 mo postop	0.37	0.60	0.07
6 mo postop	0.06	0.20	0.06
1 yr postop	0.06	0.24	0.01

Funtional score	HA/CMC injection group	Control group	P value
ROM : **Forward flexion**			
Preop	124.00	135.22	0.15
6 wk postop	134.89	135.11	0.97
3 mo postop	144.22	148.11	0.53
6 mo postop	160.44	158.11	0.63
1 yr postop	165.11	165.67	0.89

Discussion & Conclusion

ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

King Chulalongkorn Memorial Hospital The Thai Red Cross Society

- Functional outcome, as measured by the **American Shoulder & Elbow Score (ASES)** was significantly higher in the treatment group than the control group at **6 months postoperatively**. ($p < 0.05$)

- Shoulder range of motion was also better in the treatment group but no significant differences were observed between the two groups.

- No statistically significant differences postoperative pain and constant score between the groups at all time-points. (2 weeks, 6 weeks, 3 months, 6 months, and 1 year postoperatively).

Summary :

- The intraoperative injection of hyaluronate/carboxymethyl cellulose (HA/CMC) during arthroscopic rotator cuff repair resulted in a statistically significant improvement in the American Shoulder & Elbow Score (ASES) at 6 months postoperatively.

- However, no significant differences were observed between the HA/CMC group and control group in shoulder range of motion (forward flexion), Constant Score (CS), or Visual Analog Scale for pain (VAS) across the evaluated time points.

References

- Huberty DP, Schoolfiled JD, Brady PC, Vadala AP, Arrigoni P, Burkhart SS. Incidence and treatment of postoperative stiffness following arthroscopic rotator cuff repair. Arthroscopy. 2009;25(8):880-90.
- Day M, Westermann R, Duchman K, Gao Y, Pugely A, Bollier M, Wolf B. Comparison of short-term complication after rotator cuff repair : open versus arthroscopic. Arthroscopy. 2017;34(4):1-7.
- Brislin KJ, Field LD, Savoie FH 3rd. Complications after arthroscopic rotator cuff repair. Arthroscopy. 2007;23(2):124-8.
- Harryman DT II, Matsen FA III, Sidles JA, Arthroscopic management of refractory shoulder stiffness. Arthroscopy. 1997;13:133-47.
- Ozeki M, Jin D, Miyaoka Y, Masubuchi S, Hirokawa F, Hayashi M, et al. Comparison of a chymase inhibitor and hyaluronic acid/carboxymethylcellulose (seprafilm) in a novel peritoneal adhesion model in rats. PloS One. 2019;14(1):e0211391.
- Wiig M, Abrahamsson SO, Lundberg G. Effects of hyaluroan on cell proliferation and collagen synthesis : a study of rabbit flexor tendons in vitro. J Hand Surg Am. 1996;21:599-604.
- Tuncay I, Ozbek H, Atik B, Ozen S, Akpinar F. Effects of hyaluromic acid on postoperative adhesion of tendo calcaneus surgery : an experimental study in rats. J Foot Ankle Surg. 2002;41(2): 104-8.
- Chen WY, Abatangelo G. Functions of hyaluronan in wound repair. Wound Repair Regen. 1999;7(2) :79-89.
- Honda H, Gotoh M, Kanazawa T, Ohzono H, Nakamura H, Ohta K, et al. Hyaluronic acid accelerates tendon-to-bone healing after cuff repair. Am J Sports Medicine. 2017;45(14):3322-30.
- Oryan A, Moshiri A, Meimandi Parizi AH, Jahromi AR. Repeated administration of exogenous sodium-hyaluronate improved tendon healing in an vivo transection model. J tissue Viability. 2012;21 :88-102.
- Brecht M, Mayer U, Schlosser E, Prehm P. Increased hyaluronate synthesis is required for fibroblast detachment and mitosis. Biochem. J. 1986;239(2):445-50.
- Correia AR. Adhesion prevention in laparoscopic surgery. J Gynecologic surg. 2014;30(4):196-203.
- Kim T, Ahn KH, Choi DS, Hwang KJ, Lee BI, Jung MH, et al. A randomized, multi-center, clinical trial to assess the efficacy and safety of alginate carboxymethylcellulose hyaluronic acid compared to carboxymethylcellulose hyaluronic acid to prevent postoperative intrauterine adhesion. J Minimal Invasice Gynecol. 2012;19(6):731-6.
- Kim SG, Song KY, Lee HH, Kim EY, Lee JH, Jeon HM, et al. Efficacy of an antiadhesive agent for the prevention of intra-abdominal adhesions after radical gastrectomy : a prospective randomized, multicenter trial. Medicine. 2019;98:19(e15141).

References

- Bae DS, Woo JW, Paek SH, Kwon H, Chai YJ, Kim SJ. Antiadhesive effect and safety of sodium hyaluronate-carboxymethyl cellulose membrane in thyroid surgery. J Korean Surg Soc. 2013;85(5) :199-204.
- Namkaew J, Laowpanitchakorn P, Sawaddee N, Jirajessada S, Honsawek S, Yodmuang S. Carboxymethyl cellulose entrapped in a poly(vinyl) alcohol network : plant-based scaffolds for cartilage tissue engineering. Molecules. 2021;26(3):578-92.
- Priya G, Madhan B, Narendrakumar U, Suresh Kumar RV, Manjubala I. In vitro and in vivo evaluation of carboxymethyl cellulose scaffolds for bone tissue engineering applications. ACS Omega. 2021;6:1246-53.
- Liuyun J, Yubao L, Chengdong X. Preparation and biological properties of a novel composite scaffold of nano-hydroxyapatite/chitosan/carboxymethyl cellulose for bone tissue engineering. J Biomedical Science. 2009;16(65).
- Rahman S, Hasan S, Nitai AS, Nam S, Karmaka AK, Ahsan S, et al. Recent developments of carboxymethyl cellulose. Polymers. 2021;13(8):1345-92.
- Shibata Y, Midorikawa K, Emoto G, Naito M. Clinical evaluation of sodium hyaluronate for the treatment of patients with rotator cuff tear. J Shoulder Elbow Surg. 2001;10:209-16.
- Pederzini LA, Milandri L, Tosi M, Prandini M, Nicoletta F. Preliminary clinical experience with hyaluronan anti-adhesion gel in arthroscopic arthrolysis for posttraumatic elbow stiffness. J Orthop Traumatol. 2013;14(2):109-14.
- Oh CH, Oh JH, Kim SH, Cho JH, Yoon JP, Kim JY. Effectiveness of subacromial anti-adhesive agent injection after arthroscopic rotator cuff repair : prospective randomized comparison study. Clinics in Orthop Surg. 2011;3:55-61.
- Chung PK, Yoo JC, Jeong JY. Effectiveness of the anti-adhesive agent protescal after arthroscopic rotator cuff repair : a retrospective study. Clinics in Shoulder Elbow. 2017;20(1):3-9.
- Jeong JY, Chung PK, Yoo JC. Effects of sodium hyaluronate/carboxymethyl cellulose (Guardix-sol) on retear rate and postoperative stiffness in arthroscopic rotator cuff repair patients : a prospective cohort study. J Orthop Surg. 2017;25(2):1-8.
- Kim J, Kim Y, J W, Nam JH, Kim SH. Effects of a thermosensitive antiadhesive agent on single-row arthroscopic rotator cuff repair. J Sports Med Am. 2020;1-8.
- Cvetanovich GL, Gowd AK, Liu JN, Nwachukwu BU, Cabarcas BC, Cole BJ, et. al. Establishing clinically significant outcome after arthroscopic rotator cuff repair. J Shoulder Elbow Surg. 2019;28(5):939-48.
- Franceschi F, Papalia R, Palumbo A, Vasta S, Maffulli N, Denaro V. Management of postoperative shoulder stiffness. Sports Med Arthrosc Rev 2011;19:420-7.
- Kim JH, Lee JH, Yoon JH, Chang JH, Bae JH, Kin KS. Antiadhesive effect of the mixed solution of sodium hyaluronate and sodium carboxymethylcellulose after endoscopic sinus surgery. Am J Rhinol. 2007;21:95-9.