YONSEI UNIVERSITY

ISAKOS CONGRESS 2025

MUNICH GERMANY June 8–11

Marrow Stimulation for Full-thickness Trochlear Cartilage Defects in Patients Undergoing High Tibial Osteotomy Shows Favorable Cartilage Regeneration with Maintained Three-dimensionally Measured TT-TG Distance

Byeong-Hun Jeon, MD.[1], Se-Han Jung, MD.[1], Min Jung, MD. PhD.[1], Kwangho Chung, MD.[2], Hyun-Soo Moon MD., PhD.[3], Sung-hwan Kim,MD. PhD.[1].

1. Severance Hospital, Yonsei University College of Medicine
2. Yongin Severance Hospital, Yonsei University College of Medicine
3. Gangnam Severance Hospital, Yonsei University College of Medicine

Severance

Disclosures

- ✓ The authors do not have a financial interest or other relationship with a commercial company or institution.

- ✓ The authors do not have any affiliations or conflict of interest notifications to disclose.

Background & Purpose

- ***Trochlear cartilage defects (TCDs)*** are common in patients undergoing medial open-wedge high tibial osteotomy (MOWHTO).

- However, there exists a paucity of studies reporting the outcomes after treating these TCDs with cartilage regeneration procedures.

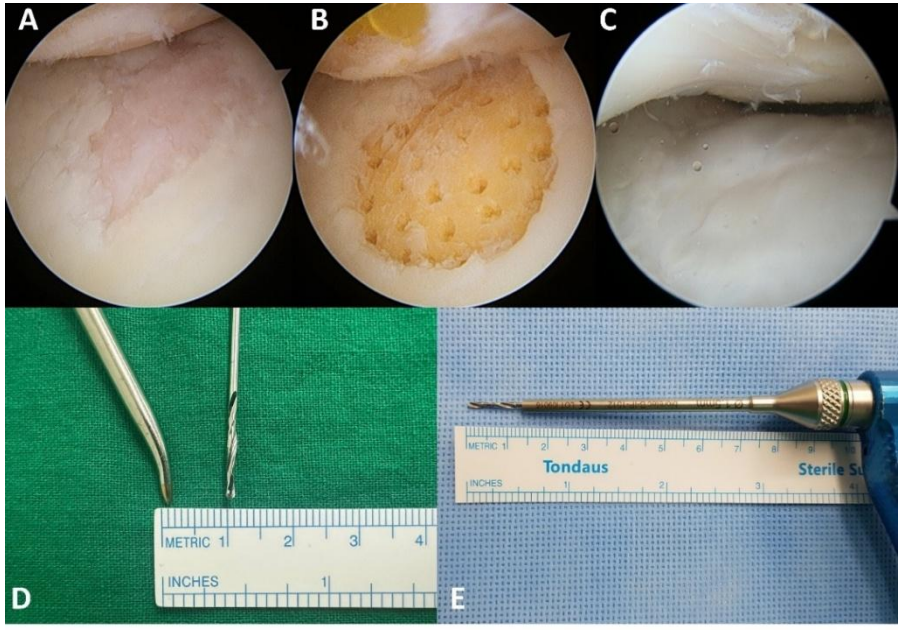
- This study aims to assess clinical outcomes and cartilage regeneration after additional *arthroscopic marrow stimulation for full-thickness TCDs during MOWHTO* and analyze *perioperative changes in parameters associated with PF biomechanics.*

Methods

- ***Thirty-eight patients (38 knees)*** who underwent ***arthroscopic marrow stimulation for TCDs*** combined with MOWHTO were retrospectively reviewed.

- **Arthroscopic marrow stimulation : *Microdrilling vs. Microfracture***
  - ***Microdrilling: Smaller, deeper, and denser perforations***
  - ***Microfracture: Larger, spaced-out perforations***

- The mean follow-up period: 27.0 months.



Methods

- ✓Clinical assessments were performed using **patient-reported outcomes(PROs).**

- ✓**MRI and second-look arthroscopy** were used to assess ***cartilage regeneration***.

- ✓The ***3D measurements of parameters associated with patellar biomechanics*** were performed.

  *: **TT-TG distance, modified Q-angle, patellar tilt, tibial torsion angle,*** **DF-DTR**

Results - Baseline characteristics

Variables	Values
Age, yrs	58.2±4.4
Sex (male/female), n (%)	4 (10.5) / 34 (89.5)
Affected side (right/left), n (%)	22 (57.9) / 16 (42.1)
Body mass index, kg/m^2	27.6±5.0
ICRS Grade of trochlear cartilage lesion	
ICRS grade 3, n (%)	27 (71.1)
ICRS grade 4, n (%)	11 (28.9)
Trochlear cartilage defect size, cm^2	2.6±1.4
Patellofemoral kissing lesions, n (%)	14 (36.8)
Combined Lateral retinacular release, n (%)	9 (23.7)
K-L grade of tibiofemoral joint, 0/1/2/3/4	0/0/4/29/5
Weight-bearing line ratio	16.4±12.5
Blackburn-Peel index	0.7±0.1
Sulcus angle	136.9±4.5
Congruence angle	-1.1±8.9

Results - Clinical outcomes

PROs	Pre	1-year F/U	Last F/U	p-value	MCID achievement rate
VAS	58.8±21.3	19.8±14.4	18.3±12.7	<.001	30/38 (78.9%)
Lysholm	46.5±21.0	68.0±16.4	74.7±14.6	<.001	30/38 (78.9%)
KOOS pain	48.9±17.2	72.2±14.9	77.0±14.4	<.001	26/38 (68.4%)
KOOS symptom	49.2±15.4	68.9±13.8	71.9±14.8	<.001	24/38 (63.2%)
KOOS ADL	56.7±17.7	76.4±13.4	80.6±12.2	<.001	26/38 (68.4%)
KOOS sports	20.0±19.1	35.1±23.0	44.3±22.1	<.001	26/38 (68.4%)
KOOS QOL	26.8±15.8	49.1±18.9	54.3±20.5	<.001	18/26 (69.2%)
Kujala AKPS	42.7±16.7	58.3±13.1	66.6±14.0	<.001	30/38 (78.9%)

- ✓ **Significant improvement in PROs**
  - VAS pain score reduced (58.8 → 18.3)
  - Lysholm score increased (46.5 → 74.7)
  - KOOS (Pain, Symptoms, ADL, Sports, QOL) all improved
- ✓ **MCID achievement rates: 63.2% ~ 78.9%**

Results - MRI/Arthroscopic assessment

	Values
Mean total MOCART score	64.3±15.9
Volume fill	15.3±5.3 /20
Integration	9.7±5.7 /15
Surface	4.1±3.0 /10
Structure	1.0±3.1 /10
Signal intensity	9.3±2.9 /15
Bony defect	7.6±2.9 /10
Subchondral change	17.2±2.9 /20

	Values
ICRS CRA overall points	9.0±2.9
ICRS CRA grade	
Grade I	6 (15.8%)
Grade II	23 (60.5%)
Grade III	6 (15.8%)
Grade IV	3 (7.9%)
Coverage of cartilage lesion, %	85.4±26.2
Success rate (Grade I-II)	29/38 (76.3%)

- ✓ **Median MOCART score: 70**
- ✓ **Success rate: 76.3%** (82.8% in microdrilling vs. 55.5% in microfracture)

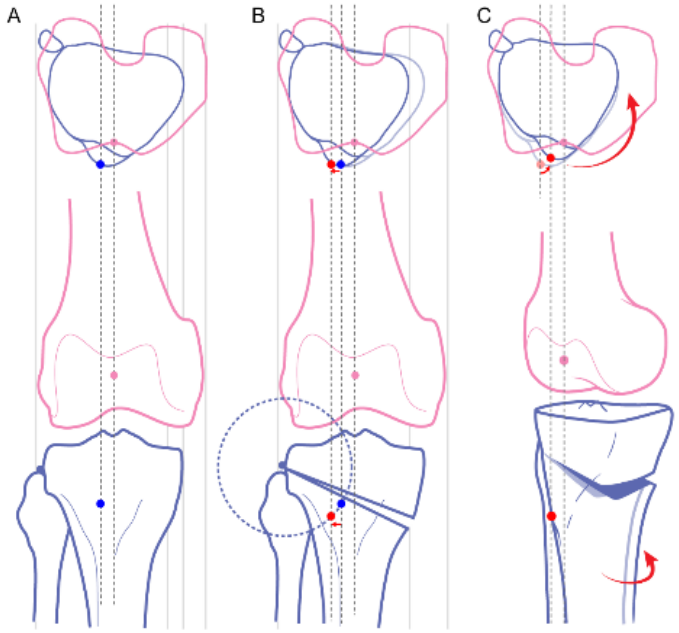
Results - Subgroup analysis results

Microdrilling group (n=29)	Success group (n=24)	Failure group (n=5)	P value
ICRS CRA overall points	10.4±1.2	3.8±2.8	<0.001*
Microdrilling, n (%)	24 (82.8)	5 (55.5)	.174
Cartilage defect size, cm²	2.5±1.1	3.7±1.1	.016*
PF kissing lesion, n (%)	8 (33.3)	4 (80)	.130
Preoperative ICRS grade 4 lesions, n (%)	6 (25)	2 (40)	.597
Lateral retinacular release, n (%)	7 (29.2)	2 (40)	.633

- ✓ **Failure Group had larger defects** (3.7 ± 1.1 cm² vs. 2.5 ± 1.1 cm²)
- ✓ Each 1 cm² increase → **2.4** × higher failure risk
- ✓ **Cutoff value: 2.85 cm² for predicting failure** (AUC = 0.838, p = 0.019)

Results -3D Biomechanical Changes

3D parameters	Preop	Postop	P value
Patellar height	0.66±0.09	0.61±0.08	<.001*
Patellar tilt angle	9.5±4.6	6.9±4.5	<.001*
TT-TG distance	11.2±3.7	10.6±4.4	.227
Modified Q angle	18.8±4.7	16.9±4.6	.002*
Tibial torsion angle	18.6±7.7	14.1±8.4	<.001*
DF-DTR	18.4±8.9	13.1±8.7	<.001*



- ✓ **Distal femur-distal tibia rotation (DF-DTR) decreased** (-5.3°, p <0.001)
  - → Indicates internal rotation of the distal tibia
- ✓ **TT-TG distance was maintained** (10.6 mm vs. 11.2 mm, p=0.227)
  - **related to decreased DF-DTR** (r=0.583, p=0.001)

Limitations & Future Directions

- **Limitations:**
  - Small sample size
  - No control group (MOWHTO alone vs. with microdrilling)
  - Short-term follow-up (~26 months)

- **Future Research:**
  - Long-term follow-up on cartilage durability
  - Comparative studies with other cartilage repair techniques

Conclusion

- **Arthroscopic marrow stimulation for TCDs** combined with MOWHTO showed **favorable cartilage regeneration**, especially when the defect size was smaller and microdrilling was utilized

- **A defect size of 2.85 cm^2 was the cutoff value** to predict the failure after the mircrodrilling procedure for TCDs.

- **TT-TG distance was maintained**, whereas **the modified Q-angle significantly decreased** despite the valgus realignment procedure. **The TT-TG distance is correlated with DF-DTR.**

References

1 Eldracher M, Orth P, Cucchiarini M, Pape D, Madry H (2014) Small subchondral drill holes improve marrow stimulation of articular cartilage defects. Am J Sports Med 42(11):2741-2750

2 Hinterwimmer S, Feucht MJ, Paul J, Kirchhoff C, Sauerschnig M, Imhoff AB, Beitzel K (2016) Analysis of the effects of high tibial osteotomy on tibial rotation. Int Orthop 40(9):1849-1854

3 Jacobi M, Villa V, Reischl N, Demey G, Goy D, Neyret P, Gautier E, Magnussen RA (2015) Factors influencing posterior tibial slope and tibial rotation in opening wedge high tibial osteotomy. Knee Surg Sports Traumatol Arthrosc 23(9):2762-2768

4 Kim JI, Kim BH, Han HS, Lee MC (2020) Rotational Changes in the Tibia After High Tibial Valgus Osteotomy: A Comparative Study of Lateral Closing Versus Medial Opening Wedge Osteotomy. Am J Sports Med 48(14):3549-3556

5 Kraeutler MJ, Aliberti GM, Scillia AJ, McCarty EC, Mulcahey MK (2020) Microfracture Versus Drilling of Articular Cartilage Defects: A Systematic Review of the Basic Science Evidence. Orthop J Sports Med 8(8):2325967120945313

6 Schreiner MM, Raudner M, Marlovits S, Bohndorf K, Weber M, Zalaudek M, Röhrich S, Szomolanyi P, Filardo G, Windhager R, Trattnig S (2021) The MOCART (Magnetic Resonance Observation of Cartilage Repair Tissue) 2.0 Knee Score and Atlas. Cartilage 13(1_suppl):571s-587s

7 Song IS, Kwon J (2022) Analysis of changes in tibial torsion angle on open-wedge high tibial osteotomy depending on the osteotomy level. Knee Surg Relat Res 34(1):17

8 van den Borne MP, Raijmakers NJ, Vanlauwe J, Victor J, de Jong SN, Bellemans J, Saris DB (2007) International Cartilage Repair Society (ICRS) and Oswestry macroscopic cartilage evaluation scores validated for use in Autologous Chondrocyte Implantation (ACI) and microfracture. Osteoarthritis Cartilage 15(12):1397-1402