Lumbar MRI Phenotype Analysis of Degenerated Discs in Patients with Discogenic Low Back Pain Following Intradiscal Platelet-Rich Plasma Releasate Treatment

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INTRODUCTION: Intervertebral disc (IVD) degeneration is clinically evaluated by magnetic resonance imaging (MRI). Lumbar MRI phenotypes, including Modic changes [1], disc bulging [2], and high-intensity zones (HIZs) [3], are reported to be related to low back pain (LBP).

Platelet-rich plasma (PRP) is an autologous blood concentrate containing several hundreds of bioactive proteins [4], which has been used to treat musculoskeletal disorders and stimulate tissue regeneration and repair [4]. PRP has been reported to potentially promote IVD cell metabolism in vitro and regenerative effects on degenerated IVDs in several animal models [4]. PRP has recently become a clinical option for treating degenerative disc diseases. A previous randomized, double-blind, active-controlled clinical trial evaluated the efficacy and safety of the releasate isolated from PRP (PRPr) injection into degenerated discs of patients with discogenic LBP [5]. The intradiscal treatment of PRPr was safe and maintained improvements in pain and LBP-related disability for 60 weeks. However, whether intradiscal administration of PRPr induces tissue repair and/or regenerative effects, which improve the MRI phenotypes (findings) related to disc degeneration, has not been investigated.

This study aimed to retrospectively evaluate time-dependent changes in MRI phenotypes (Modic changes, disc bulging, and HIZs) after intradiscal injection of PRPr for patients with discogenic LBP in a previous randomized clinical trial.

METHODS: 1. Study design and patients: This study was a retrospective analysis of a previous randomized, double-blind, active-controlled clinical trial conducted between February 2018 and September 2020 [5]. The institutional Clinical Research Ethics Review Committee approved this retrospective study. In short, patients received an intradiscal injection of either PRPr or corticosteroids (CS). Patients from both the PRPr and CS groups who still experienced pain received PRPr as optional treatment at eight weeks post-injection. As a result, among the 16 patients, 15 received optional injections of PRPr 8 weeks after the initial injection. The efficacy of PRPr was evaluated for up to 12 months (52 weeks) after optional injection (Post 12M).
2. MRI assessment: MRI data at baseline and Post 12M were retrospectively evaluated. **a)** The extent of IVD degeneration of the targeted discs at baseline and Post 12M was evaluated using a modified Pfirrmann [6] grading system. **b)** Modic and vertebral body marrow changes adjacent to the endplate were evaluated as previously reported [7]. Type I was defined by areas of hypo-intensity on T1-weighted image (T1WI) and hyperintensity on T2-weighted image (T2W), type II by areas of hyperintensity on both T1WI and T2WI, and type III by areas of hypo-intensity on both T1WI and T2WI. **c)** Disc bulging is a generalized extension of the disc beyond the edges of the vertebral ring apophyses [8]. Disc bulging was evaluated by discs extending into the spinal canal beyond the edge of the apophyses at the mid-sagittal section of T2WI of the lumbar spine. **e)** A HIZ was diagnosed as a high-intensity signal identified within the posterior AF on T2WIs of the lumbar spine [3]. The area of posterior HIZ was determined in the regions of interest (ROI) framing the border of the HIZ on setting on mid-sagittal T2WI MR.

RESULTS SECTION: 1. Patient characteristics: Fifteen patients (mean age: 33.9±9.5 years, 11 men, 4 women) were included in this study. The CS group included six patients (mean age: 32.2±6.8 years), and the PRPr group included nine patients (mean age: 34.9±11.3 years). A total of 19 discs were used for the analyses. No significant differences in age, sex, number of targeted discs, and modified Pfirrmann classification were found between the groups. There were no significant differences between the groups in the prevalence of Modic changes, disc bulging, or posterior HIZs by patient or disc level.
2. MRI-graded disc degeneration: No significant differences in the MRI-grades were found between the two groups (CS: 4.6 ± 0.7, PRPr: 4.5 ± 0.9). No significant time-dependent changes in the MRI grades were also found in both groups.
3. Modic changes: Modic changes adjacent to the targeted discs were found in 21.1% of the targeted discs at baseline (two discs in the CS group and two discs in the PRPr group). Modic types 2 and 3 were found on the two discs. There were no significant differences in the prevalence of Modic changes between the CS and PRPr groups at baseline. The prevalence and types of Modic changes did not change at Post 6M and 12M.
4. Disc bulging: At baseline, a disc bulging was identified in 63.2% of the targeted discs (12 discs in 11 patients). There was no significant difference in the prevalence of disc bulge between the PRPr and CS groups at baseline (P=0.53). The prevalence of disc bulge did not change at Post 6M and 12M.
5. HIZs: HIZs in the posterior AF were identified in 68.4% of the targeted discs (13 discs in 11 patients) at baseline. No significant difference in prevalence was observed between the CS and PRPr groups. Three discs (15.8%) were of the round type, and ten discs (52.6%) were of the vertical type. One vertical-type HIZ in the posterior AF disappeared at Post 12M after shrinking (Fig. 1). Other HIZs showed no changes in prevalence or type. The area of posterior HIZs in the total targeted discs significantly decreased time-dependently (P<0.05); however, no significant differences were found between the groups (P=0.1, Fig. 2).

DISCUSSION: For the first time, the current study evaluated the MRI phenotypes related to discogenic LBP following IVD therapy using PRPr. There were no significant changes in the MRI-graded disc degeneration and prevalence of Modic changes, disc bulges, and HIZs, suggesting that no pronounced regenerative effect of PRPr on IVD degeneration could be confirmed. However, the area of posterior HIZs decreased time-dependently, implying that the intradiscal injection of PRPr may have limited potential to stimulate the tissue repair of posterior AF tears that lead to the shrinkage of the area of posterior HIZs.

SIGNIFICANCE/CLINICAL RELEVANCE: The intradiscal treatment of PRPr did not induce the changes in the prevalence of MRI phenotypes related to disc degeneration; however, it may have limited potential to stimulate the tissue repair of posterior AF tears.

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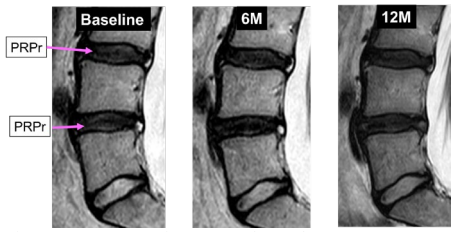

Fig. 1. Representative case of Lumbar MRI

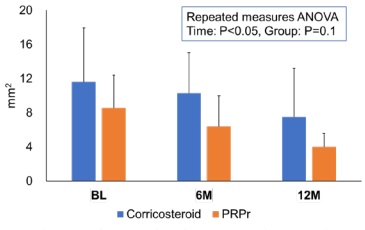

Fig. 2 Change in the area of posterior HIZs