Research Article (Araştırma Makalesi)

The Results of Lomber Disc Hernia Patients Treated with Disc Restoration Hydrogel Implant (Gelstix^{tm}): A Retrospective Cohort Study

Disk Restorasyon Hidrojel İmplantı (Gelstix^{tm}) ile Tedavi Edilen Lomber Disk Hernisi Hastalarının Sonuçları: Retrospektif Bir Kohort Çalışması

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Özet

Amaç: Lomber disk hernisi hastalarında disk restorasyon hidrojel implant (GelstixTM) uygulanmasının kliniğimizdeki sonuçlarını değerlendirmek amaçlanmıştır.

Gereç ve Yöntemler: Fırat Üniversitesi Hastanesi Algoloji Polikliniği'ne başvuran lomber disk hernisi tanısı almış,kronik diskojenik ağrılı, Ocak 2013–Ocak 2014 tarihleri arasında bir yıllık sürede disk restorasyon hidrojel uygulanan hastalar retrospektif olarak değerlendirildi. Olgular demografik karakteristikleri,magnetik rezonans görüntüleme bulguları, preoperatif ve postoperatif vizüel analog skala (VAS) skorları, komplikasyonlar, yan etkiler ve işlem sonrası hasta memnuniyeti açısından incelendi.

Bulgular: Yirmi beşi erkek (%40,3), 37'si kadın (%59,7) toplam 62 hastaya işlem yapıldı. Hastaların yaş ortalaması 49,18 ± 14,18 yıl,kadın hastaların yaşları 50,81±13,37 yıl ve erkek hastaların yaşları 46,76±15,27 yıldı. Kadın ve erkek hastaların ağrı süreleri sırasıyla 37,81±37,92 ay ve 25,36±33,58 aydı. Preoperatif ve postoperatif VAS skorları kadın hastalarda 8,24±1,09 ve 3,56±2,11; erkek hastalarda 7,88±1,01 ve 3,76±2,17 idi. Onaltı (% 25,8) sağ bacak ağrısı, 20(%32,3) sol bacak ağrısı, 26(%41,9) bilateral alt ekstremite ağrısıyla kliniğimize başvurdu. Hastaların 31'inde (%50) ek bir hastalık olmadığı, 12'sinde (%19,4) kardiak hastalık, 3'ünde (%4,8) respiratuar hastalık, 7'sinde (%11,3) endokrin hastalık, 4'ünde (%6,5) endokrin ve kardiyak hastalık beraber, 2'sinde (%3,2) kardiyak ve respiratuar hastalık beraber, 1'inde (%1,6) endokrin ve respiratuar hastalığın beraber ve 2'sinde (%3,2) endokrin, kardiyak ve respiratuar ek hastalığının beraber olduğu görüldü. Hastaların 25'inde bulging (%40,3), 5'inde protrüzyon (%8,1), 4'ünde NFD (%6,5), 18'inde bulging + NFD (%29), 3'ünde NFD + protrüzyon(%4,8) ve 7'sinde bulging + protrüzyon (%11,3) vardı. Onüç hastanın (%20,97) daha önce tedavi almadığı, 29'unun (%46,77) transforaminal steroid tedavisi aldığı ve 20'sinin(%32,26) sadece medikal tedavi aldığı tespit edildi. Şikayet seviyesi 2 hastada L2-L3 (%3,2), 17'sinde L3-L4 (%27,4), 28'inde L4-L5 (%45,2) ve 15'inde L5-S1'di (%24,2). Memnun olmayan hasta sayısı 9(%14,5), orta derecede memnun kalan hasta sayısı 16(%25,8), iyi derecede memnun olan hasta sayısı 16 (%25,8), mükemmel derecede memnun olan hasta sayısı ise 21'di (%33,9).

Sonuç: Disk restorasyon hidrojel özellikle genç ve orta yaş hastalarda diskojenik ağrıya karşı tatmin edici sonuçlarla kullanılabilen, düşük komplikasyon ve yan etki riskine sahip güvenli bir minimal invazif tekniktir.

Anahtar Kelimeler: Bel ağrısı, Lumber Disk Hernisi, İntervertebral Disk, Disk Restorasyon Hidrojel İmplant

Abstract

Objective: This study aims to evaluate the results of disc restoration hydrogel implanted (GelstixTM) lumber disc hernia patients.

Materials and Method: Patients suffering from chronic back pain diagnosed with lumber disc hernia who were admitted to Firat University Algology Clinic and treated with disc restoration hydrogel between January 2013 and January 2014 were evaluated. Cases were evaluated for demographic characteristics, magnetic resistance imaging findings, preoperative and postoperative visual analog scale (VAS) scores, complications, side effects, and patient satisfaction after the procedure.

Results: Of the operated 62 patients were 25 male (40.3%) and 37 female (59.7%). The mean age of all patients was 49.18±14.18 years, the mean age of female patients was 50.81±13.37 years and the mean age of male patients was 46.76±15.27 years. The mean duration of pain in female and male patients was 37.81±37.92 months and 25.36±33.58 months, respectively. Preoperative and postoperative VAS scores of female patients were 8.24±1.09 and 3.56±2.11; male patients were 7.88±1.01 and 3.76±2.17, respectively. Of the 62 patients suffered from 16 right leg pain (25.8%), 20 left leg pain (32. 3%), and 26 bilateral lower limb pain (41.9%). Of 62 patients 31 had no additional disorders (50%), 12 had cardiac disorders (19.4%), 3 had (4.8%) respiratory disorders, 7 had endocrine disorders (11.3%), 4 had both endocrine and cardiac disorders (6.5%), 2 had both cardiac and respiratory disorders (3.2%), 1 had both endocrine and respiratory disorders (1.6%), and 2 had both endocrine, cardiac and respiratory disorders (3.2%). Of the 62 patients 25 had bulging (40.3%), 5 had protrusion (8.1%), 4 had narrowed neural foramen (6.5%), 18 had bulging+narrowed neural foramen (29%), 3 had narrowed neural foramen + protrusion (4.8%) and 7 had bulging + protrusion (11.3%). Thirteen patients hadn't had previous therapy (20.97%), transforaminal steroid injection was applied to 29 patients (46.77%), and medical therapy (such as NSAID, miyorelactants) was applied to 20 (32.26%). Levels of complaints were 2 at L2-L3 (3. 2%), 17 at L3-L4 (27.4%), 28 at L4-L5 (45.2%), and 15 at L5-S1 (24.2%). Without L2-L3 level other operated levels had significant differences between preoperative VAS scores and postoperative VAS scores. The number of unsatisfied patients was 9 (14.5%), moderated satisfied patients number 16(25.8%), good satisfied patients number was 16 (25. 8%), and perfectly satisfied patients number was 21 (33.9%).

Conclusion: Disc restoration hydrogel is a safe minimal invasive technique with satisfactory results, low complication rates, and low side effect risk especially in young and middle-aged patients.

Keywords: Back Pain, Lomber Disc Hernia, Intervertebral Disc, Disc Restoration Hydrogel Implant

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INTRODUCTION

Mechanical low back pain refers to the disorder arising from problems of the spine, intervertebral disc, or the soft tissue surrounding the spine (1,2). Lumbar disc hernia is one of the most common causes of mechanical low back pain and is frequently observed at the L4-L5 and L5-S1 levels, between 30–50 years of age (1–3). A slipped intervertebral disc exerts pressure on the spinal nerve roots, spinal cord, and nearby pain-sensitive structures. Sensory, motor, and reflex defects may manifest as back and leg pain, limited range of motion in the lower back, muscle spasms of the lumbar spine, and a positive straight leg raise test due to pressure exerted by the slipped disc on the nerve root (2,4). Only 5%–10% of the patients with lumbar disc herniation require surgery. Most patients respond well to conservative methods such as rest, pharmacological treatment, physical therapy and rehabilitation (analgesic currents, hot–cold applications, traction, and exercise), manipulation, spinal orthosis, as well as epidural and paravertebral stem blocks (4–6). Percutaneous intradiscal therapies (nucleolysis, nucleotomy, intradiscal implant, or injection) can be used following conservative treatment and in the treatment algorithm (7–10).

Intradiscal implantation or injection aims at restoring disc height, not narrowing it, unlike other minimally invasive methods such as percutaneous nucleolysis and nucleotomy. In experimental studies, intradiscal hydrogel implantation increases the regeneration of the damaged disc and restores the normal range of motion (ROM) (11). Hydrogel implants for disc restoration safely interact with surrounding tissues, have small volumes, and cause low-level inflammation. Hydrogel absorbs water from the surrounding tissue and swells up to ten times its initial volume, causing the disc range to be restored (12). Many in vivo and in vitro studies have shown that hydrogel implants positively affect the prognosis of degenerative disc disease (DDD) by absorbing water and increasing the pH level and lumbar ROM; these are safe to insert (11–15).

This study aimed to evaluate the results of the hydrogel implant (GelstixTM) application, which has been mostly used in experimental studies, in minimally invasive surgery for patients with lumbar disc hernia.

MATERIALS AND METHODS

Selection of Patients

This study was performed with the approval of the Ethics Committee for Clinical Research, Faculty of Medicine, Fırat University (decision number of 16-04) on September 30, 2014. In our study, 79 patients with chronic discogenic pain, who were diagnosed with lumbar disc hernia by anamnesis, physical examination, and imaging methods [magnetic resonance imaging (MRI)], and who had a hydrogel implant (GelStixTM, Parimed Medical Products, Inc., Stansstad/Switzerland) applied between January 2013 and January 2014, were retrospectively evaluated. The patient record was created along with the pain assessment form in the first application at the hospital. Demographic profiles of the patients, characteristics of pain, allergy status, history of disease and medication, as well as physical examination, radiological, and postoperative findings, were obtained from patient registration records.

Exclusion Criteria: Hydrogel implants (GelStixTM, Parimed Medical Products, Inc., Stansstad/Switzerland) for disc restoration were not used in patients with low back pain due to inflammation, tumors, fractures, annulus fibrosis ruptures, extruded and sequestrated discs, and severe depression as well as those who were pregnant. Patients with missing data were not included in the study **(Figure 1)**.

Patients were evaluated twice, before hydrogel implantation application and six months after the end of treatment. They were asked to rate patient satisfaction, based on the Odom Criteria, after the procedure as poor (1 point), fair (2 points), good (3 points), and excellent (4 points. Verbal responses were recorded (16).

Demographic data of patients, preoperative MRI findings, previous treatments, pain duration, visual analog scale (VAS) scores before and six months after the procedure, and patient satisfaction based on Odom's criteria, were recorded.

Method

Study Population

Patients were hospitalized on the day before the surgery and routine examinations were conducted. Seventeen patients with missing data were excluded, and the study was conducted with the remaining 62 patients who met the criteria and had undergone hydrogel implant application.

Techniques

To prevent the risk of infection, 1 g of cefazolin (Cezol; Deva Holding, İstanbul/TURKEY) was intravenously administered to the patients, an hour before the procedure, and they were monitored, positioned in the prone position in the procedure room. Midazolam (Dormicum; Deva Holding, İstanbul/TURKEY) (0.02 mg/kg) and fentanyl (Fentanyl; Johnson&Johnson, New Brunswick, New Jersey/USA) (1µg/kg) were administered for sedoanalgesia. Sterilization was provided for C-arm fluoroscope imaging. The 16–18 G guiding needle was inserted into the disc space using anteroposterior and lateral imaging of the C-arm scope. After confirming the needle position in the disc

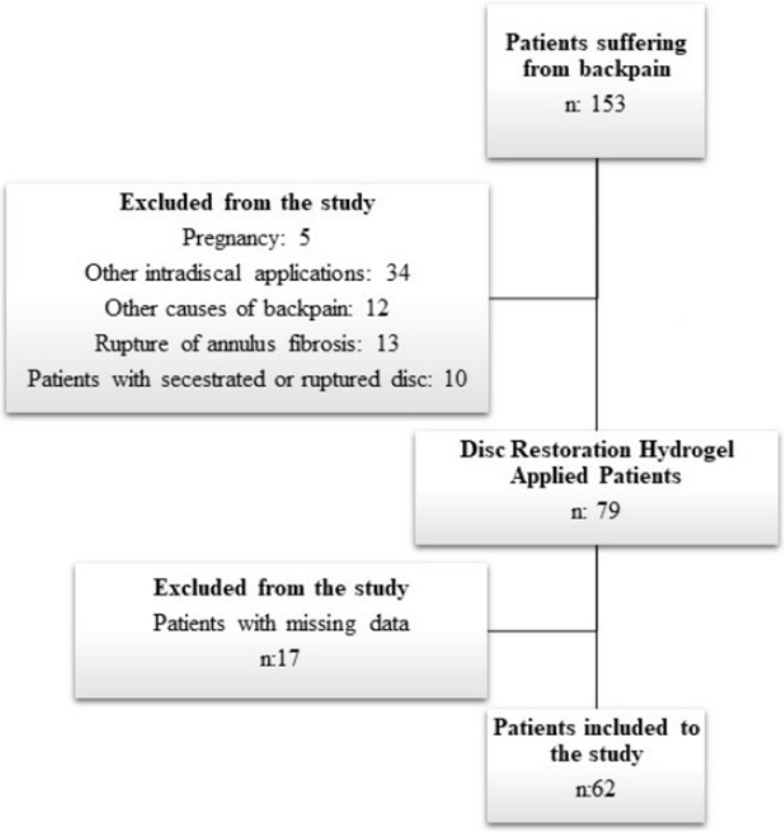

Figure 1. Flowchart of the study design

space, the loaded implant holder was placed at the end of the needle. The hydrogel implant (GelstixTM; Parimed Medical Products, Inc., Stansstad/Switzerland) was inserted into the disc by pushing the implant holder. The procedure was repeated thrice with the three hydrogel implants available in one package. The position of the needle in the disc space for each application was confirmed using fluoroscopy. The needle was pulled out, and a sterile bandage was applied to the application area. After the procedure was completed, 0.2 mg flumazenil was administered to antagonize the sedation, and the patients were followed up within the unit for four hours. Patients without motor or sensory deficits were discharged within 24 hours after the procedure.

Statistical Analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) software version 15.0. Normal distribution of the data was evaluated using the Kolmogorov–Smirnov test. For normally distributed numerical data, a paired sample t-test was used for analyzing the pre- and post-procedure parameters of the patients in addition to the descriptive statistical analysis (mean and standard deviation). For comparing the differences between the groups, the post hoc Tukey's HSD test was used after variance analysis. Repeated measurements of each group were analyzed using the Wilcoxon signed-rank test for data that did not show normal distribution. Results were represented in the 95% confidence interval; values of $p<0.05$ were considered statistically significant.

RESULTS

Of the 79 patients who underwent the procedure, 62 were included in the study, including 25 men (40.3%) and 37 women (59.7%). The mean age of the patients was 49.18 ± 14.18 years (min–max: 15–77 years). Preoperative pain, other diseases, and previous pain treatments of the patients are shown in **Table 1**.

Preoperative pain duration and pre and postoperative VAS scores did not reveal a statistically significant difference between male and female patients **(Table 2)**.

Pre and postoperative VAS scores of 62 patients with hydrogel implants (GelstixTM) were 8,096 ± 1.07 (min–max: 6–10) and 3.65 ± 1.12 (min–max: 1–8), respectively. The difference between pre and postoperative VAS scores of all patients was statistically significant ($p<0,001$).

Patient satisfaction based on Odom criteria was assessed in the sixth month of follow-up after the surgery. Consequently, satisfaction scores in nine patients (14.5%) were found to be poor; 16 (25.8%), fair; 16 (25.8%), good; and 21 (33.9%), excellent **(Figure 2)**.

Table 1. Demographic data of patients, complaints on hospital admission, other diseases, and magnetic resonance imaging pathologies

		Number (n)	Percentage (%)
Gender	**Male**	25	40,3
	Female	37	49,7
Preoperative Complaint	**Right leg pain**	16	25,8
	Left leg pain	20	32,3
	Bilateral lower extremity pain	26	41,9
Other diseases	**No**	31	50
	Cardiac	12	19,4
	Respiratory	3	4,8
	Endocrine	7	11,3
	Endocrine + Cardiac	4	6,5
	Endocrine + Respiratory	1	1,6
	Respiratory + Cardiac	2	3,2
	Endocrine + Respiratory + Cardiac	2	3,2
Previously applied treatment	**No**	14	22
	Medical	19	31
	Treatment-Free Survival	29	47

Table 2. Age, duration of pain and pre and postoperative (sixth-month) VAS scores based on gender

	Male	**Female**	***p* value**
Age (year)	46,76 ± 15,27 (23–73)	50,81 ± 13,37 (15–77)	0,27
Duration of pain (month)	37,81 ± 37,92 (1–120)	25,36 ± 33,58 (1–120)	0,19
Preoperative VAS score	8,24 ± 1,09 (6–10)	7,88 ± 1,01 (6–10)	0,73
Postoperative sixth-month VAS score	3,56 ± 2,11 (1–8)	3,76 ± 2,17 (1–8)	0,19

VAS;The Visual Analogue Scale

When comparing the patients according to age groups (20–40, 40–60, and over 60 years), satisfaction levels in patients over 60 years of age were poor in five patients; fair, eight; and excellent, one. In those aged 40–60 years, satisfaction scores in four patients were poor; six, fair; 11, good; and 11, excellent. Satisfaction scores in two patients aged 20–40 years indicated fair; six, good; and eight, excellent **(Figure 3)**.

There were no complications reported during and after the procedure.

DISCUSSION

Lumbar disc herniation due to degenerative disc disease is more common in older patients, but it can also be observed in all age groups. Although the number of female patients with lumbar disc hernia was higher in our study, it was found to be more in male patients in the literature (3,17). Nucleus pulposus replacement in patients with a healthy annulus fibrosus may reduce pain while simultaneously restoring spinal mobility and delaying disc degeneration (18,19).

Lumbar disc herniation can be treated with less invasive methods, except for 5-10% of patients who require surgery (6). Appropriate treatment selection is important in these patients. Reducing pain is the main goal and for this purpose, nonsteroidal anti-inflammatory drugs and myorelaxants are used in symptomatic treatment in the first step (20). Apart from these, minimally invasive techniques such as epidural transforaminal local steroid injections, and transforaminal root injection, can be used in symptomatic treatment in patients resistant to medical therapy. (20). In addition, intradiscal interventions are used for those who plan to close the disc space (nucleoplasty, intradiscal electrothermal therapy, chemonucleolysis) and techniques for regaining disc volume (GelStixTM) (20,21).

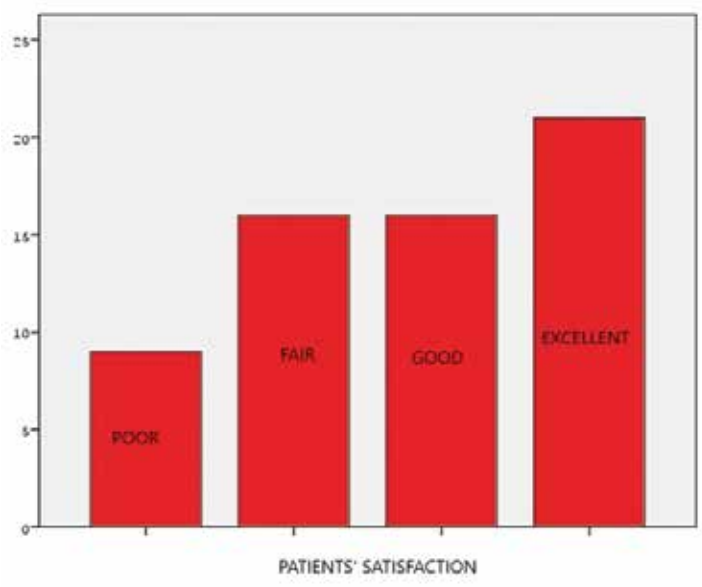

Figure 2. Satisfaction levels of all patients based on Odom's Criteria, six months after the procedure

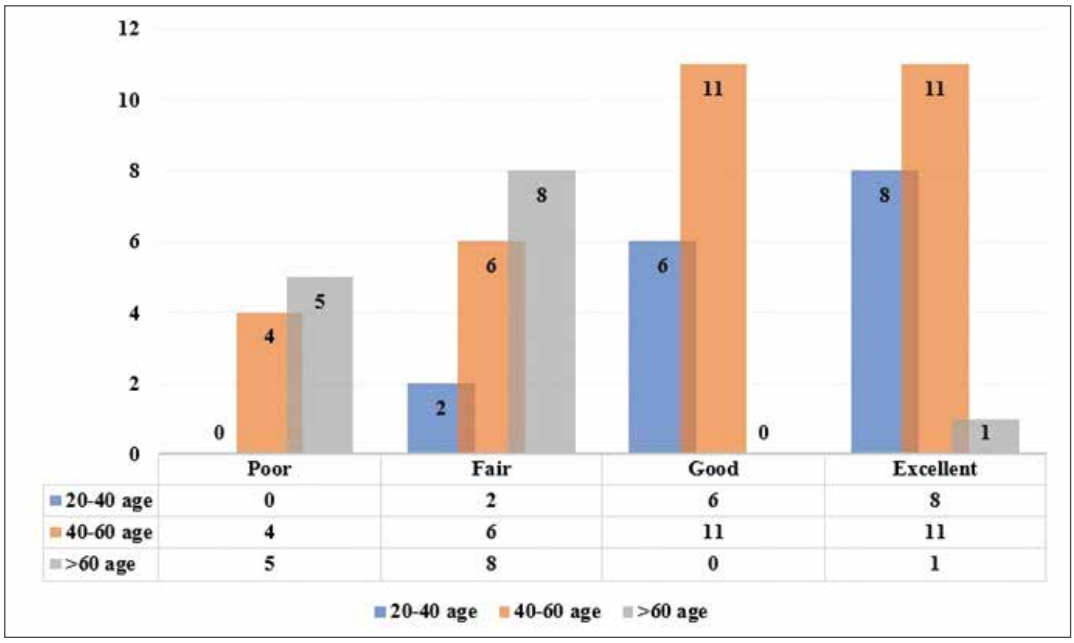

Figure 3. Satisfaction levels of all patients according to the age groups based on Modified Odom Criteria, six months after the procedure

Hydrogels are hydrophilic polymers that can swell in water and hold a large amount of water without dissolving (22,23). Hydrogels can replace the nucleus pulposus by expanding and increasing their weight and volume on absorbing water (21); they also decrease fibrosis and encapsulation (21). The last group of synthetic hydrogels is hydrolyzed polyacrylonitrile. It is a family of thermoplastic hydrogels, based on acrylic multiblock copolymers. GelstixTM belongs to this last group (21). Protein and lipids can be deposited on the surface of hydrophobic polymers due to denaturation. Cell adhesion proteins may be denatured and can lead to cellular attachment and fibrosis. Hydrogels, due to their high water content, are resistant to lipid and cell attachment (21), thus causing fewer side effects. In line with the available literature, we did not observe any side effects (such as allergic reactions) in our study.

Zhu et al. evaluated MRI findings of patients with chronic low back and radicular pain, and who underwent nucleoplasty due to disc protrusion; they observed a 54% improvement rate in pain in their study (24). Weiner and Flasser administered transforaminal epidural steroid injections to 28 patients with severe radiculopathy due to herniated lumbar disc, who did not respond to epidural steroid injection and physical therapy. They observed a drastic reduction in the pain levels of patients during the 3.4-year follow-up (25). The pain could not be reduced in only three of the patients, which required surgical intervention.

In the experimental study by Gullbrand et al., it was shown that hydrogels successfully applied to the degenerated sheep spine improved the structure of the nucleus pulposus and annulus fibrosus (26). Hirase et al. indicated in their review that platelet-rich plasma, another material that can be intradiscally applied, reduces pain in patients with disc degeneration (27). Considering the satisfaction levels in our study, 21 patients stated the procedure was excellent (33.9%); 16, good (25.8%); 16, fair (25.8%); and nine, poor. On excluding the scores of the nine patients with poor satisfaction ratings, 85.5% of the patients were found to be satisfied with the procedure, similar to that found in previous studies. Similar to the literature, the difference between pre and postoperative VAS scores was statistically significant.

Application of disc restoration hydrogel (GelstixTM) is a safe and minimally invasive technique, with a low risk of complications and side effects. It has satisfactory clinical outcomes against discogenic pain, especially in young and middle-aged patients. However, there is a growing need for further clinical studies evaluating the effectiveness of this procedure.

Ethical approval: Fırat University, Faculty of Medicine, Clinical Studies Ethical Commitee, Session no. 16, Decision no. 04, on 30/09/2014. An informed consent form was taken from the participants.

Authors' contribution: The authors declare that they have contributed equally to the study.

Conflicts of interest: The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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