10.22088/caspjrm.12.2.4

Caspian J Reprod Med, 2026, 12 (2): 4 -10

Caspian Journal of Reproductive Medicine

Journal homepage: www.caspjrm.ir

Original

Agreement between laparoscopic and histopathological diagnosis in women with advanced endometriosis: A retrospective cross-sectional study

Roya Padmehr [1a], Amirhossein Shahbandi [2a], Maryam Hashemnezhad [3], Samira Abdollahi [3], Mina Ataei [1, 4, *], Zahra Sehat [5]

[1] Reproductive Biotechnology Research Centre, Avicenna Research Institute (ARI), Academic Centre for Education, Culture and Research (ACECR), Tehran, Iran
[2] Alborz University of Medical Sciences, Karaj, Iran
[3] Department of Obstetrics and Gynecology, School of Medicine, Kamali Hospital, Alborz University of Medical Sciences, Alborz, Iran
[4] Department of Obstetrics and Gynecology, Social Determinants of Health, Research Center, School of Medicine, Alborz University of Medical Sciences, Karaj, Iran
[5] Avicenna Research Institute (ARI), Academic Centre for Education, Culture and Research (ACECR), Tehran, Iran
a: These authors contributed equally and are first authors

Received: 12 Jun 2026 Accepted: 25 Sep 2026

Abstract

Background: Laparoscopy is widely used for the surgical diagnosis of endometriosis, whereas histopathological examination remains the reference standard for confirming the disease. Although visual diagnosis during laparoscopy is considered reliable for typical lesions, its agreement with histopathological findings may vary according to lesion location. This study aimed to evaluate the agreement between laparoscopic diagnosis and histopathological confirmation in women with advanced endometriosis.

Methods: This retrospective cross-sectional study reviewed the medical records of women aged 15–55 years who underwent laparoscopic surgery for stage III or IV endometriosis between 2016 and 2021 at two referral centers in Tehran and Alborz, Iran. Endometriosis was staged according to the revised American Society for Reproductive Medicine (rASRM) classification. Laparoscopic findings were compared with histopathological results, and overall as well as site-specific percentage agreement was calculated.

Results: A total of 1,836 women were included. Overall, laparoscopic and histopathological diagnoses were concordant in 1,659 cases (90.4%), whereas discordance was observed in 177 cases (9.7%). Agreement exceeded 95% for lesions involving the uterosacral ligaments, right ovary, recto cervical region, and posterior vagina. Lower agreement was observed for appendiceal (57.3%) and omental (75.0%) lesions, suggesting that concordance between laparoscopic and histopathological findings varied according to anatomical location.

Conclusion: Laparoscopic findings demonstrated a high level of agreement with histopathological diagnosis in women with advanced endometriosis, particularly for lesions at common pelvic sites. However, lower agreement at certain anatomical locations indicates that histopathological examination remains an important component of diagnosis, especially for atypical lesions or when alternative pathological conditions are suspected. Because agreement was evaluated using descriptive measures, further prospective multicenter studies incorporating comprehensive diagnostic agreement and diagnostic accuracy analyses are warranted to validate these findings.

Keywords: Abortion, Heart Diseases, Maternal Mortality, Premature Birth; Pulmonary Arterial, Hypertension

***Correspondence author:** Dr. Mina Ataei, **ORCHID ID:** https://orcid.org/0000-0002-0935-7837, **Email:** ataee.mina20@gmail.com

Publisher: Babol University of Medical Sciences This work is published as an open access article distributed under the terms the Creative Commons Attribution 4.0 License (http://creativecommons.org/licenses/by-nc/4). Non-commercial uses of the work are permitted, provided the original work is properly cited.

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]

Introduction

Endometriosis is a chronic, benign gynecological disorder characterized by the presence of endometrial-like tissue outside the uterine cavity (1). The disease most commonly affects the ovaries, uterosacral ligaments, pelvic peritoneum, rectovaginal septum, cervix, vagina, and other pelvic structures, although extra-pelvic involvement may also occur (2). Malignant transformation is uncommon, occurring in approximately 1% of affected women, with the ovary representing the most frequent site (2).

Endometriosis primarily affects women of reproductive age and is commonly associated with chronic pelvic pain, dysmenorrhea, dyspareunia, infertility, and ovarian masses (3–5). Although the highest prevalence has been reported among women aged 25–35 years (6, 7), the disease has also been identified in premenarchal girls (8) and in 2–5% of postmenopausal women (9). Clinical presentation is highly variable, ranging from asymptomatic disease to severe pelvic pain and infertility. Patients may also experience abnormal uterine bleeding, gastrointestinal symptoms, urinary complaints, and fatigue (10, 11). Physical examination findings depend on the location and extent of disease and may include pelvic tenderness, adnexal masses, nodularity of the posterior fornix, and reduced uterine mobility; however, a normal pelvic examination does not exclude the diagnosis of endometriosis (12, 13).

Accurate diagnosis remains a major challenge because the clinical manifestations of endometriosis are often nonspecific and overlap with those of other gynecological and gastrointestinal disorders. Histopathological examination of surgically excised lesions has traditionally been regarded as the reference standard for confirming the diagnosis (37, 38). Nevertheless, laparoscopic visualization remains the cornerstone of surgical evaluation, and experienced surgeons frequently rely on the characteristic macroscopic appearance of lesions during operative assessment (14). The diagnostic performance of laparoscopy may vary according to lesion morphology, anatomical location, disease severity, and surgical expertise (15, 16). A systematic review reported a sensitivity of 94%, specificity of 79%, positive predictive value of 76%, and negative predictive value of 98% for laparoscopic diagnosis compared with histopathological examination (17). However, histopathological confirmation may occasionally be negative despite characteristic laparoscopic findings because of inadequate tissue sampling, sampling of nonrepresentative lesions, or histological variability within lesions (18).

The revised American Society for Reproductive Medicine (rASRM) classification is widely used to stage endometriosis according to the extent and distribution of disease (19). Although histopathological examination remains the reference standard for confirmation, routine biopsy of every visually suspected lesion remains controversial, particularly when lesions display typical laparoscopic features. In clinical practice, surgeons frequently rely on visual assessment to guide intraoperative decision-making; therefore, understanding the degree of concordance between laparoscopic findings and histopathological confirmation is clinically important. Furthermore, agreement may differ according to anatomical location because lesions at uncommon sites can mimic other pathological conditions, potentially affecting the reliability of visual diagnosis.

Despite the widespread use of laparoscopy, relatively limited evidence has evaluated its agreement with histopathological findings across different anatomical locations in women with advanced endometriosis. Therefore, this study aimed to evaluate the agreement between laparoscopic diagnosis and histopathological confirmation of endometriosis in women with stage III and IV disease and to assess whether the level of agreement varies according to lesion location.

Materials and Methods

Study Design and Setting

This retrospective cross-sectional study was conducted by reviewing the medical records of women who underwent laparoscopic surgery for endometriosis between 2016 and 2021 at two referral centers affiliated with Avicenna Research Institute in Tehran and Alborz University of Medical Sciences, Iran. Patient information was extracted from medical records using a standardized data collection checklist. Endometriosis was staged according to the rASRM classification, and the anatomical location of laparoscopically suspected lesions was recorded (19). Tissue specimens obtained during surgery were routinely submitted for histopathological examination.

Study Population

The study included women aged 15–55 years with surgically confirmed stage III or IV endometriosis according to the rASRM classification who underwent laparoscopic surgery during the study period. To maximize the sample size and minimize selection bias, all eligible patients with complete medical records and available histopathological reports were included. Patients with incomplete medical records or unavailable histopathological findings were excluded from the analysis.

Data collection

Demographic characteristics, including age, height, weight, body mass index (BMI), and marital status, were extracted from the medical records. Surgical data included the rASRM stage and the anatomical location

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]

of all laparoscopically suspected endometriotic lesions documented in the operative reports. Histopathological reports were reviewed to determine whether the excised lesions were confirmed as endometriosis.

The primary outcome was the concordance between the laparoscopic impression and histopathological confirmation of endometriosis. Agreement was evaluated overall and according to the anatomical location of the lesions by calculating the proportion of laparoscopically suspected lesions that were confirmed by histopathological examination.

Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Ethics Committee of Alborz University of Medical Sciences (Approval No. IR.ABZUMS.REC.1401.137).

Statistical analysis

Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequency and percentage. The agreement between laparoscopic findings and histopathological results was evaluated overall and according to the anatomical location of the lesions using descriptive statistics. A two-sided P value < 0.05 was considered statistically significant.

Results

A total of 1,836 women met the eligibility criteria and were included in the analysis. Participants were predominantly of normal weight and married, with advanced-stage endometriosis (rASRM Stage IV) representing the vast majority of the sample (Table 1).

Overall, laparoscopic findings were concordant with histopathological diagnosis in 1,659 of 1,836 cases, corresponding to an overall agreement of 90.35%. Discordance between the two diagnostic methods was observed in 177 cases (9.65%).

The level of agreement varied according to the anatomical location of the lesions (Table 2). The highest agreement rates (≥95%) were observed for lesions involving the right ovary (95.0%), left and right uterosacral ligaments (95.7% and 97.4%, respectively), the recto cervical region (97.1%), the posterior cervix (96.0%), and the posterior vagina (95.5%).

Table 1. Demographic and clinical characteristics of the study participants (n = 1,836)

Variable	M ± SD	Range
Age (years)	36.3 ± 6.2	23–55
Height (cm)	163.70 ± 5.60	151–179
Weight (kg)	65.4 ± 7.8	40–91
Body mass index (kg/m²)	24.4 ± 2.6	15.4–34.9
Characteristic	**n**	**%**
BMI category		
<25 kg/m²	1,105	60.2
25.0–29.9 kg/m²	664	36.2
≥30 kg/m²	67	3.6
Marital status		
Married	1,597	86.97
Unmarried	239	13.03
rASRM stage		
Stage III	287	15.62
Stage IV	1,549	84.38

Note. BMI = body mass index; rASRM = revised American Society for Reproductive Medicine.

Complete agreement (100%) was observed for lesions involving the rectal serosa, rectal muscle, rectal mucosa, mesorectum, abdominal wall, right pelvic wall, and right uterine artery. However, these findings should be interpreted with caution because the number of lesions at several of these anatomical sites was small. Moderate agreement was observed for lesions involving the left and right fallopian tubes (85.2% and 85.3%, respectively), bladder (88.6%), left and right ureters (91.0% and 92.4%, respectively), rectum (91.3%), and left pelvic wall (91.7%). The lowest agreement rates were identified for appendiceal lesions (57.3%) and omental lesions (75.0%). Among appendiceal lesions, several laparoscopically suspected cases were not confirmed as endometriosis by histopathological examination and were subsequently diagnosed as alternative pathological conditions, including adenocarcinoma and melanoma.

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]

Table 2 Agreement between laparoscopic and histopathological diagnosis according to lesion location

Lesion location	Histopathology positive, n	Histopathology negative, n	Agreement (%)	Total (n)
Left ovary	210	21	90.9	231
Right ovary	210	11	95.0	221
Left uterosacral ligament	156	7	95.7	163
Right uterosacral ligament	148	4	97.4	152
Left fallopian tube	156	27	85.2	183
Right fallopian tube	133	23	85.3	156
Left ureter	81	8	91.0	89
Right ureter	85	7	92.4	92
Appendix	47	35	57.3	82
Bladder	39	5	88.6	44
Rectal serosa	17	0	100.0	17
Rectocervical region	34	1	97.1	35
Rectal muscle	58	0	100.0	58
Rectal mucosa	15	0	100.0	15
Right pelvic wall	8	0	100.0	8
Left pelvic wall	11	1	91.7	12
Abdominal wall	9	0	100.0	9
Rectum	116	11	91.3	127
Posterior cervix	96	4	96.0	100
Uterus	1	8	11.1	9
Posterior vagina	21	1	95.5	22
Mesorectum	4	0	100.0	4
Omentum	3	1	75.0	4
Right uterine artery	3	0	100.0	3
Overall	**1,659**	**177**	**90.35**	**1,836**

These findings suggest that the degree of concordance between laparoscopic and histopathological diagnosis may differ according to anatomical location, particularly at uncommon sites where other pathological conditions may mimic endometriosis.

Discussion

This retrospective cross-sectional study evaluated the agreement between laparoscopic diagnosis and histopathological confirmation of endometriosis in women with stage III and IV disease. Overall, laparoscopic findings were concordant with histopathological diagnosis in 90.35% of cases, indicating a high level of agreement in this population. However, the degree of agreement varied according to the anatomical location of the lesions, suggesting that the reliability of laparoscopic visual assessment may differ across disease sites.

Laparoscopy remains the standard surgical approach for the evaluation of suspected endometriosis because it enables direct visualization of pelvic lesions and facilitates simultaneous surgical management (20). Nevertheless, the accuracy of visual diagnosis may be influenced by several factors, including lesion morphology, anatomical location, disease severity, and the surgeon's experience (21–24). In the present study, agreement between laparoscopic and histopathological findings was highest for lesions involving the ovaries, uterosacral ligaments, rectocervical region, and posterior vagina. These anatomical sites are among the most common locations of advanced endometriosis and often exhibit characteristic macroscopic features that facilitate intraoperative recognition. Consequently, visual diagnosis at these sites appears to correspond closely with histopathological confirmation.

In contrast, lower agreement was observed for appendiceal and omental lesions. These findings should be interpreted cautiously because these anatomical sites represented a relatively small proportion of the study population. In addition, several appendiceal lesions that were suspected intraoperatively to represent endometriosis were subsequently diagnosed as alternative pathological

[Downloaded from caspjrm.ir on 2026-11-14]
[DOI: 10.22088/caspjrm.12.2.4]

conditions, including adenocarcinoma and melanoma. This observation highlights the importance of histopathological examination when lesions are identified at uncommon anatomical locations or demonstrate atypical intraoperative appearances, where visual assessment alone may be insufficient to establish the diagnosis.

Our findings are generally consistent with previous studies reporting high concordance between laparoscopic and histopathological diagnosis of endometriosis, particularly for ovarian and uterosacral ligament lesions (25, 26). Wanyonyi et al. also reported that the ovaries and posterior cul-de-sac were the most common sites of disease; however, the proportion of histopathological confirmed lesions in their study was lower than that observed in the present investigation (27). These differences may be explained by variations in patient characteristics, disease severity, surgical expertise, lesion distribution, histopathological interpretation, and study design. Importantly, the present study included only women with advanced-stage (stage III and IV) endometriosis, in whom lesions are generally more extensive and visually recognizable than those observed in earlier stages of disease. This may have contributed to the relatively high overall agreement observed in our cohort.

Although the overall percentage agreement was high, the findings should not be interpreted as a comprehensive assessment of diagnostic accuracy. Agreement in the present study was evaluated using descriptive measures, and additional indices such as Cohen's kappa coefficient, sensitivity, specificity, positive predictive value, negative predictive value, and confidence intervals could not be calculated because the original patient-level data required for these analyses were unavailable. Therefore, the reported findings reflect descriptive concordance between laparoscopic and histopathological diagnosis rather than a complete evaluation of diagnostic performance.

The demographic characteristics of the study population should also be interpreted within the context of the study design. Most participants had stage IV disease, a normal body mass index, and were married. These findings describe the characteristics of women included in this retrospective cohort and should not be interpreted as evidence of associations between these variables and the occurrence or severity of endometriosis. Because of the retrospective cross-sectional design, causal relationships cannot be inferred.

The present study has several strengths. It included a large sample of women with surgically managed advanced endometriosis from two referral centers and evaluated agreement according to multiple anatomical locations. This site-specific analysis provides clinically relevant information regarding the reliability of laparoscopic diagnosis across different disease locations. Nevertheless, several limitations should be considered. The retrospective design limited control over data quality and the availability of clinical information. The inclusion of only women with stage III and IV disease limits the generalizability of the findings to patients with early-stage endometriosis. Furthermore, agreement was assessed using descriptive measures only, and interobserver variability among surgeons and pathologists was not evaluated. These factors should be considered when interpreting the findings.

Overall, the findings suggest that laparoscopic assessment provides a high level of agreement with histopathological confirmation in women with advanced endometriosis, particularly for lesions located at common pelvic sites. However, histopathological examination continues to play an important role in confirming the diagnosis, especially when lesions are located at uncommon anatomical sites or have atypical macroscopic appearances. Future prospective multicenter studies incorporating standardized reporting methods and comprehensive measures of diagnostic agreement and diagnostic accuracy are needed to further define the role of laparoscopic assessment in the diagnosis of endometriosis.

Conclusion

In this retrospective cross-sectional study, laparoscopic findings demonstrated a high level of agreement with histopathological confirmation in women with stage III and IV endometriosis, particularly for lesions located at common pelvic sites such as the ovaries, uterosacral ligaments, recto cervical region, and posterior vagina. However, the level of agreement varied across anatomical locations, with lower concordance observed for less common sites, including the appendix and omentum.

These findings support the value of laparoscopic assessment as an important component of the surgical

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]

evaluation of advanced endometriosis. Nevertheless, histopathological examination remains essential for confirming the diagnosis, particularly when lesions have atypical appearances or involve uncommon anatomical locations where other pathological conditions may mimic endometriosis.

Because agreement was assessed using descriptive measures and more comprehensive diagnostic agreement and diagnostic accuracy statistics could not be calculated from the available data, the results should be interpreted with appropriate caution. Future prospective multicenter studies using standardized data collection and complete patient-level datasets are needed to further evaluate the agreement between laparoscopic and histopathological diagnosis using established statistical methods and to determine the generalizability of these findings to patients with earlier stages of endometriosis.

Acknowledgements

The authors thank the staff of the Reproductive Biotechnology Research Center at the Avicenna Research Institute (ACECR, Tehran) and the Department of Obstetrics and Gynecology at Kamali Hospital (Alborz University of Medical Sciences) for their assistance with data extraction and record review. We are also grateful to the patients whose medical records made this retrospective analysis possible.

Conflicts of Interest

The authors declare that they have no competing interests.

References

1. Jansen RP, Russell P. Nonpigmented endometriosis: clinical, laparoscopic, and pathologic defnition. Am J Obstet Gynecol 1986;155:1154-9.
2. Heaps JM, Nieberg RK, Berek JS. Malignant neoplasms arising in endometriosis. Obstet Gynecol 1990;75:1023-8
3. Vercellini P, Viganò P, Somigliana E, Fedele L. Endometriosis: pathogenesis and treatment. Nat Rev Endocrinol 2014; 10:261 .
4. Hickey M, Ballard K, Farquhar C. Endometriosis. BMJ. 2014 Mar 19;348:g1752. doi: 10.1136/bmj.g1752.
5. Sinaii N, Plumb K, Cotton L, Lambert A, Kennedy S, Zondervan K, Stratton P. Differences in characteristics among 1,000 women with endometriosis based on extent of disease. Fertil Steril. 2008 Mar;89(3):538-45. doi: 10.1016/j.fertnstert.2007.03.069.
6. Missmer SA, Hankinson SE, Spiegelman D, Barbieri RL, Marshall LM, Hunter DJ. Incidence of laparoscopically confirmed endometriosis by demographic, anthropometric, and lifestyle factors. Am J Epidemiol. 2004 Oct 15;160(8):784-96. doi: 10.1093/aje/kwh275.
7. Viganò P, Parazzini F, Somigliana E, Vercellini P. Endometriosis: epidemiology and aetiological factors. Best Pract Res Clin Obstet Gynaecol. 2004 Apr;18(2):177-200. doi: 10.1016/j.bpobgyn.2004.01.007.
8. Laufer MR. Premenarcheal endometriosis without an associated obstructive anomaly: Presentation, diagnosis, and treatment. Fertil Steril. 2000; 74 (3):S15 .
9. Nezhat F, Datta MS, Hanson V, Pejovic T, Nezhat C, Nezhat C. The relationship of endometriosis and ovarian malignancy: a review. Fertil Steril. 2008 Nov 1;90(5):1559-70.
10. Hansen KE, Kesmodel US, Baldursson EB, Kold M, Forman A. Visceral syndrome in endometriosis patients. Eur J Obstet Gynecol Reprod Biol. 2014;179: 198 203. doi: 10.1016/j.ejogrb.2014.05.024.
11. Vercellini P, Fedele L, Aimi G, Pietropaolo G, Consonni D, Crosignani PG. Association between endometriosis stage, lesion type, patient characteristics and severity of pelvic pain symptoms: a multivariate analysis of over 1000 patients. Hum Reprod. 2007 Jan;22(1):266-71. doi: 10.1093/humrep/del339.
12. Mehedintu C, Plotogea MN, Ionescu S, Antonovici M. Endometriosis still a challenge. J Med Life. 2014 Sep 15;7(3):349-57.
13. Revised American Society for Reproductive Medicine classification of endometriosis: 1996. Fertil Steril. 1997 May;67(5):817-21. doi: 10.1016/s0015 0282(97)81391-x.
14. Engemise S, Gordon C, Konje JC. Endometriosis. BMJ. 2010 Jun 23;340:c2168. doi: 10.1136/bmj.c2168.
15. Pardanani S, Barbieri RL. The gold standard for the surgical diagnosis of endometriosis: visual findings or biopsy results. J Gynecol Tech. 1998;4(4):121-4.

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]

16. Almeida Filho DP, Oliveira LJ, Amaral VF. Accuracy of laparoscopy for assessing patients with endometriosis. Sao Paulo Med J. 2008 Nov;126(6):305-8. doi: 10.1590/s1516-31802008000600002.
17. Wykes CB, Clark TJ, Khan KS. Accuracy of laparoscopy in the diagnosis of endometriosis: a systematic quantitative review. BJOG. 2004 Nov;111(11):1204-12. doi: 10.1111/j.1471-0528.2004.00433. x.
18. Balasch J, Creus M, Fábregues F, Carmona F, Ordi J, Martinez-Román S, et al. Visible and non-visible endometriosis at laparoscopy in fertile and infertile women and in patients with chronic pelvic pain: a prospective study. Hum Reprod. 1996;11(2):387 91. doi: 10.1093/humrep/11.2.387.
19. Duffy JM, Arambage K, Correa FJ, Olive D, Farquhar C, Garry R, et al. Laparoscopic surgery for endometriosis. Cochrane Database Syst Rev. 2014;(4):CD011031. doi: 10.1002/14651858.CD011031.
20. Martin DC, Hubert GD, Vander Zwaag R, el-Zeky FA. Laparoscopic appearances of peritoneal endometriosis. Fertil Steril. 1989;51(1):63-7. doi: 10.1016/s0015-0282(16)60429-6.
21. Martin DC, Khare VK, Parker LS. Clear and Opaque Vesicles: Endometriosis, Psammoma Bodies, Endosalpingiosis or Cancer? J Am Assoc Gynecol Laparosc. 1994;1(4, Part 2): S21. doi: 10.1016/s1074-3804(05)80935-1.
22. Stripling MC, Martin DC, Chatman DL, Zwaag RV, Poston WM. Subtle appearance of pelvic endometriosis. Fertil Steril. 1988;49(3):427-31. doi: 10.1016/s0015-0282(16)59767-2.
23. Jansen RP, Russell P. Nonpigmented endometriosis: clinical, laparoscopic, and pathologic definition. Am J Obstet Gynecol. 1986;155(6):1154-9. doi: 10.1016/0002 9378(86)90136-5.
24. Berek JS. Berek & Novak's gynecology essentials. Lippincott Williams & Wilkins; 2020 Apr 21.
25. Salehpour S, Zhaam H, Hakimirard M, Azarghashb E. Determining the Valubility of Visual Findings of Laparoscopy in Diagnosing the Endometriosis. Pajoohande. 2007; 12 (4):339-343
26. Leng JH, Lang JH, Zhao XY, Li HJ, Guo LN, Cui QC. [Visual and histologic analysis of laparoscopic diagnosis of endometriosis]. Zhonghua Fu Chan Ke Za Zhi. 2006 Feb;41(2):111-3.
27. Wanyonyi SZ, Sequeira E, Mukono SG. Correlation between laparoscopic and histopathologic diagnosis of endometriosis. Int J Gynaecol Obstet. 2011 Dec;115(3):273-6. doi: 10.1016/j.ijgo.2011.07.022.

[Downloaded from caspjrm.ir on 2026-11-14]

[DOI: 10.22088/caspjrm.12.2.4]