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Comparison of Complex Regional Pain Syndrome Prevalence Between WALANT and Regional Anesthesia in Distal Radius Fracture Surgery

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Abstract

Background: Distal radius fractures are among the most common skeletal injuries that require surgical intervention. This study compares the Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique with regional anesthesia with respect to surgical outcomes and the incidence of complex regional pain syndrome (CRPS).

Objective: This study aimed to compare the Wide-Awake Local Anaesthesia No Tourniquet (WALANT) technique with regional anaesthesia in patients undergoing distal radius fracture surgery. Specifically, it evaluated differences in surgical outcomes, including intraoperative blood loss, duration of surgery, postoperative pain, and changes in haemoglobin, and assessed the incidence of complex regional pain syndrome (CRPS) between the two groups. The findings were intended to inform clinical decision-making regarding anaesthesia selection for this common orthopaedic procedure**.**

Methods: In this Non-Randomized Clinical Trial, 59 patients with distal radius fractures were divided into two groups: 30 received WALANT, and 29 received regional anesthesia. Outcomes assessed included intraoperative blood loss, hemoglobin drop, postoperative pain (VAS score), surgery duration, and CRPS incidence.

Results: Blood loss was higher in the WALANT group (147 mL, SD = 29) compared to the regional anesthesia group (121 mL, SD = 39; p = 0.005). Hemoglobin drop was similar between groups (1.3 g/dL, SD = 2.2 vs. 1.0 g/dL, SD = 0.2; p = 0.574). Postoperative pain scores showed no significant difference (1.60, SD = 1.16 vs. 1.07, SD = 0.80; p = 0.081). Surgery duration was significantly shorter in the WALANT group (138 min, SD = 33 vs. 157 min, SD = 24; p = 0.022). CRPS incidence was lower in the WALANT group (30%) than in the regional anesthesia group (37.9%), but the difference was not statistically significant (p = 0.52).

Conclusion: Both WALANT and regional anesthesia are safe and effective for distal radius fracture surgery. WALANT offers a shorter surgical time and eliminates the need for a tourniquet, despite higher blood loss. It may be a viable and efficient alternative.

Keywords: Distal radius fracture, Wide-Awake Local Anesthesia No Tourniquet, regional anesthesia, complex regional pain syndrome.

1. Background

Distal radius fractures are among the most common musculoskeletal injuries worldwide, primarily affecting children and older adults with osteoporosis (1). These fractures, often caused by direct trauma or falls from height, can significantly impair hand function due to their proximity to the wrist joint (2). Surgical intervention is frequently required, but it carries potential postoperative complications,

including complex regional pain syndrome (CRPS) (3).

CRPS is characterized by chronic pain, skin changes, swelling, and impaired motor function, driven by inflammatory processes, neuropathy, and dysregulation of the sympathetic nervous system (4). This condition can profoundly impact patients' quality of life (5). Studies suggest that the type of anesthesia used during hand surgery may influence the incidence of CRPS (6). General anesthesia, while a standard approach, is associated with complications such as postoperative depression, drug sensitivities, and pain from tourniquet use (7).

In recent years, the Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique has emerged as an alternative to general anesthesia in hand surgery (8, 9). WALANT employs a combination of epinephrine and lidocaine to achieve local anesthesia and vasoconstriction, allowing surgery to be performed with the patient fully awake(8, 10, 11). By eliminating the need for a tourniquet, WALANT reduces postoperative pain, shortens recovery time, and lowers treatment costs (12). The technique has shown promising clinical outcomes in limited procedures, such as trigger finger release and carpal tunnel syndrome treatment (13).

However, limited evidence exists comparing WALANT directly with regional anesthesia regarding surgical complications, particularly CRPS (14). Existing studies have focused mainly on the individual benefits of these techniques, with few direct comparisons in the context of distal radius fracture surgery (15). Recent research indicates that WALANT may reduce short-term postoperative complications, but further evidence is needed to evaluate its long-term effects (16).

Given the high prevalence of distal radius fractures and the importance of minimizing surgical complications, there is a clear need for comprehensive data on the impact of different anesthesia techniques, particularly WALANT and regional anesthesia. This study aims to address this gap by providing practical evidence to guide the selection of anesthesia techniques in hand surgery.

2. Objective

This study aimed to compare the Wide-Awake Local Anaesthesia No Tourniquet (WALANT) technique with regional anaesthesia in patients undergoing distal radius fracture surgery. Specifically, it evaluated differences in surgical outcomes, including intraoperative blood loss, duration of surgery, postoperative pain, and changes in haemoglobin, and assessed the incidence of complex regional pain syndrome (CRPS) between the two groups. The findings were intended to inform clinical decision-making regarding anaesthesia selection for this common orthopaedic procedure.

3. Methods

3.1. Study design and population

A detailed summary of the trial design and reporting elements is provided in the Supplementary Table, based on the CONSORT 2010 checklist. It is a non-randomized, non-blinded study evaluating outcomes in 59 patients with distal radius fractures requiring plate fixation, including assessments of pain, surgery duration, blood loss, hemoglobin changes, and CRPS incidence over 6 months. The study population consisted of all patients admitted to our hospital in the fall and winter of 2023 with distal radius fractures requiring plate fixation. A convenience sampling approach was employed. To ensure balanced groups, patients were non-randomly assigned to either the WALANT group (30 patients) or the regional anesthesia group (29 patients) based on the surgeon's clinical judgment. The sample size was calculated using a formula for comparing two independent groups, with

the focus on the incidence of complex regional pain syndrome (CRPS). Based on prior studies, the incidence of CRPS after upper limb surgery ranges from 5% to 26% (29). Using Z1-α/2 = 1.96 and Z1-β = 0.84 (for 80% power), the required sample size was estimated at 68 patients (34 per group). However, due to practical constraints, 59 patients were enrolled, with approximately 30 per group.

Patients included in the study had distal radius fractures requiring plate fixation, were aged between 20 and 60 years, provided informed consent after receiving a full explanation of the study procedures, and had no significant underlying medical conditions that could interfere with study outcomes. Patients were excluded if they had visible or reported bone deformities in the radius that could affect treatment or surgical outcomes, open fractures due to their complexity and potential to skew results, underlying conditions such as hemophilia or similar bleeding disorders, diagnosed osteoporosis, or use of medications like antihypertensives, aspirin, anticoagulants, or systemic analgesics near the time of surgery. Additionally, patients who withdrew consent, were lost to follow-up, or had known allergies to lidocaine or epinephrine (limiting WALANT use) were excluded.

3.2. Randomization and Blinding

Patients were allocated to two groups using a non-random allocation process. Blinding was not feasible for patients or surgeons, as the anesthesia method (WALANT or regional) was discernible during the procedure. However, data analysts responsible for collecting and analyzing study outcomes were blinded to the anesthesia type to minimize bias.

3.3. Outcome

The primary outcome of the study was the occurrence of CRPS, which was evaluated using the standardized Budapest Criteria questionnaire. This tool assesses the presence of ongoing symptoms, including disproportionate pain, swelling, changes in skin color or temperature, and motor issues. Each patient was monitored for six months after surgery, with regular assessments for CRPS based on clinical observations and patient-reported symptoms consistent with the Budapest Criteria.

The secondary outcomes included four key surgical and clinical variables. First, pain intensity was measured using the Visual Analog Scale (VAS), where patients rated their pain on a scale from 0 (no pain) to 10 (worst possible pain) during and after the surgical procedure. Second, the duration of surgery was recorded in minutes from the initial incision to the completion of wound closure. Third, intraoperative blood loss was estimated by counting the number of sterile gauze pads used during the procedure, a method commonly accepted in surgical settings for approximating bleeding. Lastly, changes in hemoglobin levels were calculated by comparing pre- and postoperative blood test values. These secondary outcomes were selected to provide a comprehensive comparison of surgical safety and efficiency between the two anesthesia techniques.

3.4. Intervention

In the WALANT group, local anesthesia was administered by injecting a solution of lidocaine combined with epinephrine directly into the surgical field around the distal radius. The lidocaine provided local anesthetic effects, while epinephrine served as a vasoconstrictor to reduce bleeding. No tourniquet was used, and patients remained fully conscious throughout the procedure. This approach enabled real-time communication between the patient and the surgical team and eliminated complications associated with tourniquet

use, such as ischemic pain or nerve compression.

In contrast, patients in the regional anesthesia group received a nerve block using lidocaine to anesthetize the affected limb. A pneumatic tourniquet was applied to the upper arm before the surgical incision to control bleeding and improve surgical visualization. Similar to the WALANT group, patients under regional anesthesia were awake during the operation but did not experience the same degree of localized pharmacological vasoconstriction, relying instead on the mechanical effect of the tourniquet.

3.5. Statistics

Data were analyzed using SPSS software, with descriptive statistics including means and standard deviations for continuous variables (e.g., pain intensity, surgery duration, blood loss, hemoglobin changes) and frequencies and percentages for categorical variables (e.g., CRPS incidence). The Kolmogorov-Smirnov test assessed data normality to determine whether to use parametric (independent t-test for comparing pain intensity and surgery duration between groups, paired t-test for within-group blood loss and hemoglobin changes) or nonparametric (Mann-Whitney U test) tests for group comparisons. The Chi-square test evaluated differences in CRPS incidence by comparing observed and expected frequencies. A p-value < 0.05 was considered statistically significant.

4. Results

Participant flow through the trial is presented in the CONSORT diagram (Figure 1). A total of 59 patients met the inclusion criteria and were enrolled in the study. The overall mean age of participants was 43.56 years (SD = 13.99). As detailed in Table 1, the mean age in the regional anesthesia group was 43.90 years (SD = 14.39), while in the WALANT group it was slightly lower at 43.23 years (SD = 13.85). This age difference between groups was not statistically significant (p = 0.915). The gender distribution also showed no significant difference. In the regional anesthesia group, 55.3% of patients were male, compared to 44.7% in the WALANT group. Conversely, females constituted a higher proportion in the WALANT group (61.9%) than in the regional anesthesia group (38.1%) (p = 0.207). Fracture laterality was nearly identical across both groups, with fractures evenly distributed between the right and left sides (p = 0.914).

Assessment of patients' medical history revealed that 36 out of 59 participants (61%) reported no underlying medical conditions, while 23 patients (39%) had at least one comorbidity. A similar distribution was observed regarding medication use: 61% of patients were not on any regular medications, whereas 39% had a history of specific drug consumption. Among those with comorbidities, the most common conditions were diabetes mellitus, reported in 6 patients (26.1%), and chronic pulmonary diseases such as asthma, noted in 4 patients (17.4%). A smaller proportion, 2 patients (8.7%), reported gastrointestinal disorders such as peptic ulcer disease. Regarding drug history, among the 23 patients on regular medication, antidiabetic agents—including metformin and insulin—were the most commonly used, reported by 7 patients (30.4%). Bronchodilators and other pulmonary medications were reported by 3 patients (13.0%).

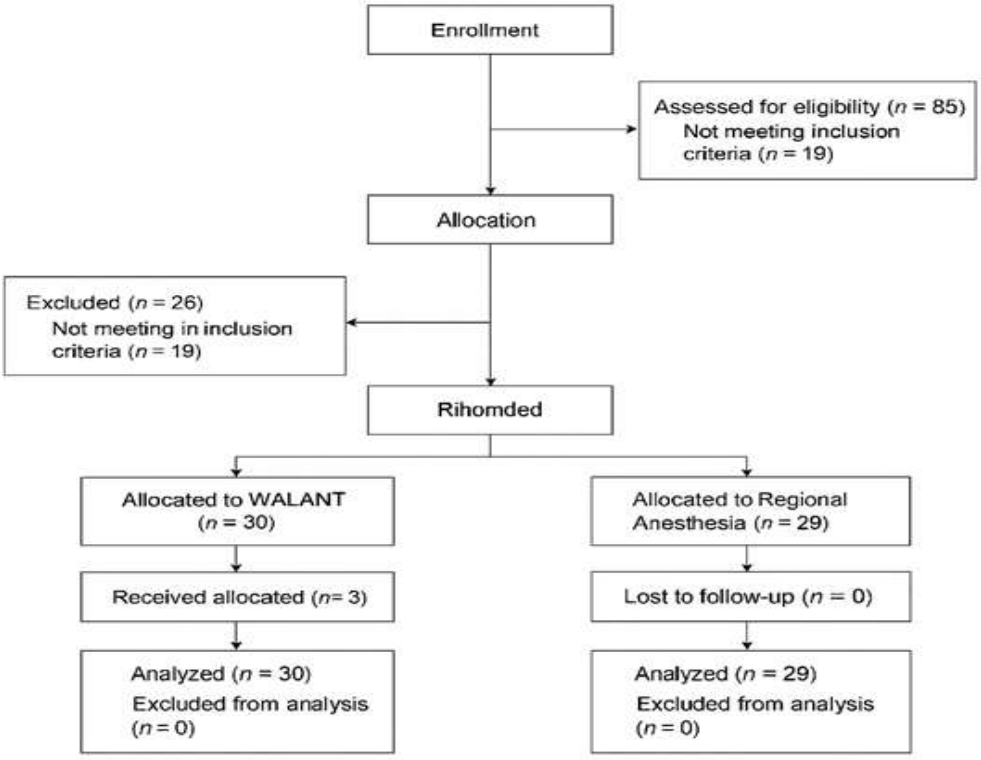

Figure 1. CONSORT flow diagram illustrating the enrollment, allocation, follow-up, and analysis of participants in the clinical trial comparing WALANT and regional anesthesia for distal radius fracture surgery.

Table 1. Demographic Characteristics of Study Population in Regional and WALANT Groups

Variable	Regional Group	WALANT Group	p-value
Age	**43.90 (14.39)**	**43.23 (13.85)**	**0.915**
Gender			**0.207**
Male	**21 (55.3%)**	**17 (44.7%)**	
Female	**8 (38.1%)**	**13 (61.9%)**	
Fracture Side			**0.914**
Right	**12 (50.0%)**	**12 (50.0%)**	
Left	**17 (48.6%)**	**18 (51.4%)**	

A comparative analysis of surgical and postoperative outcomes between the regional anesthesia and WALANT groups is presented in Table 2. The mean intraoperative bleeding volume was significantly higher in the WALANT group, averaging 147 mL (SD = 29), compared to 121 mL (SD = 39) in the regional anesthesia group (p = 0.005) (Figure 2). The mean drop in hemoglobin levels post-surgery was slightly greater in the WALANT group (1.3 g/dL, SD = 2.2) than in the regional group (1.0 g/dL, SD = 0.2), but this difference did not reach statistical significance (p = 0.574). Pain intensity, measured by the VAS, was higher in the WALANT group (mean score 1.60, SD = 1.16) than in the regional anesthesia group (1.07, SD = 0.80); however, this difference was not statistically significant (p = 0.081). Surgical duration was significantly shorter in the WALANT group, averaging 138 minutes (SD = 33), compared to 157 minutes (SD = 24) in the regional group (p = 0.022). Finally, the incidence of complex regional pain syndrome (CRPS) was lower in the WALANT group (30.0%) than in the regional anesthesia group (37.9%), but this difference was not statistically significant (p = 0.52) (Figure 3).

Table 2. Comparison of Surgical and Postoperative Outcomes Between Regional and WALANT Groups

Variable	Regional	WALANT	p-value
Bleeding Volume (ml)	121 (39)	147 (29)	0.005
Hb Drop (g/dL)	1.0 (0.2)	1.3 (2.2)	0.574
VAS (Pain Score)	1.07 (0.80)	1.60 (1.16)	0.081
Surgery Duration (min)	157 (24)	138 (33)	0.022
CRPS	11 (37.9%)	9 (30.0%)	0.52

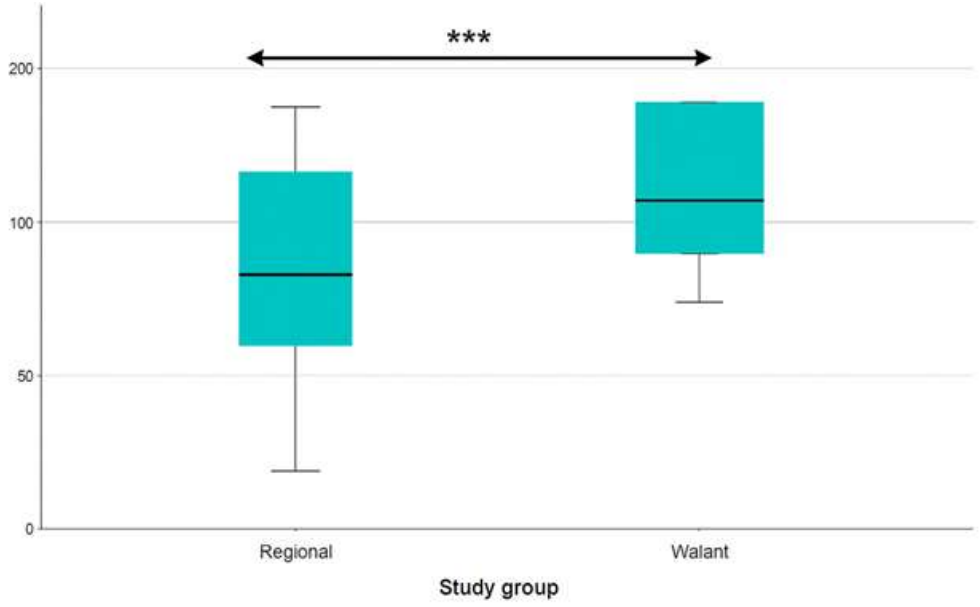

Figure 2. Boxplot comparison of intraoperative bleeding volume between the WALANT and regional anesthesia groups. The WALANT group exhibited a significantly higher bleeding volume than the regional group (p = 0.005). The triple asterisks (***) denote a statistically significant difference at the p < 0.01 level.

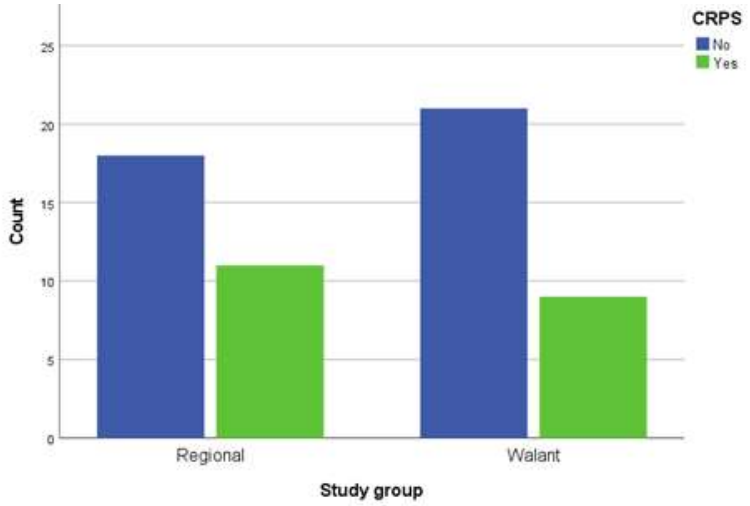

Figure 3. Clustered bar chart illustrating the incidence of complex regional pain syndrome (CRPS) in the WALANT and regional anesthesia groups. Although the WALANT group had a lower CRPS frequency (30.0%) than the regional group (37.9%), the difference was not statistically significant (p = 0.52).

5. Discussion

This clinical trial was designed to compare the outcomes of two anesthesia techniques (WALANT and regional anesthesia) in patients undergoing surgery for distal radius fractures. Participants were prospectively enrolled and assigned to either intervention group, with both surgical and postoperative parameters monitored over a six-month follow-up

period. The results demonstrated that both anesthesia methods were generally comparable in terms of safety and clinical effectiveness. While the WALANT technique was associated with increased intraoperative bleeding, it offered the advantage of a shorter surgical duration. Postoperative pain levels and hemoglobin changes were similar between groups, and no significant difference in the incidence of complex regional pain syndrome (CRPS) was observed. Overall, both techniques proved to be viable options, with distinct trade-offs in procedural characteristics.

The findings demonstrated that while the WALANT technique resulted in significantly greater intraoperative bleeding, it offered the advantage of shorter surgical duration, without significant differences in postoperative pain, hemoglobin drop, or CRPS incidence compared with regional anesthesia. These findings align closely with those of Rigny et al. (17), who also reported no significant differences in pain intensity or CRPS rates between the two techniques, while highlighting increased bleeding with WALANT. The consistency of these outcomes across different populations reinforces the external validity and clinical reliability of WALANT as a practical anesthesia approach. Moreover, Abitbol et al. (17) similarly confirmed the benefits of WALANT in enhancing early return to function and recovery. However, in contrast to Abitbol's findings, our study observed a significantly shorter surgery time in the WALANT group, and uniquely reported bleeding volumes, offering a deeper evaluation of intraoperative parameters not addressed in their work.

Other comparative studies further support the utility of WALANT, while offering nuanced differences. For instance, the study by Huang (18) emphasized WALANT's capacity for safe bleeding control and complication reduction; however, their reported bleeding volume was markedly lower than ours, likely due to differences in infiltration technique or measurement methods. Additionally, unlike our study, Huang's investigation did not include a comparison group, limiting the strength of its conclusions. Orobach et al. also described WALANT as a safe, pain-controlling option, yet their small sample size (n = 5) restricted the generalizability of their findings (19). In contrast, our study included a more robust cohort and offered a comprehensive comparison of surgical bleeding, hemoglobin changes, and CRPS occurrence. Abd Hamid et al. similarly reported comparable CRPS and range-of-motion outcomes between WALANT and regional anesthesia, though they found longer operative times in the WALANT group—possibly due to variability in surgeon expertise or case complexity (20). Despite these supportive findings, our study had limitations, including a modest sample size, non-randomized allocation, and unaccounted confounders such as surgeon experience or baseline patient health. Furthermore, the six-month follow-up period may not be sufficient to capture long-term complications, such as delayed-onset CRPS, underscoring the need for future large-scale, randomized studies with extended follow-up.

The calculated sample size required to achieve 80% power was 68 patients; however, only 59 patients were enrolled due to practical constraints. This smaller sample size reduces the study's statistical power and increases the risk of a Type II error, particularly for our primary outcome of CRPS incidence, for which the observed difference was not statistically significant. Consequently, the findings should be interpreted as preliminary. Additionally, the non-randomized design introduces a risk of selection bias, as group allocation was based on clinical judgment rather than random assignment. Potential confounding variables, such as surgeon experience,

fracture complexity, and patient comorbidities, were not fully controlled, which may have influenced the surgical outcomes. The six-month follow-up period, while adequate for short-term complications, may not capture long-term effects such as late-onset CRPS or functional recovery. Despite these limitations, the study possesses notable strengths, including a clearly defined comparison between two commonly used anesthesia techniques, consistent follow-up using standardized clinical criteria, and the inclusion of both intraoperative and postoperative outcome measures. The prospective nature of data collection and the focus on clinically relevant variables such as bleeding volume, pain intensity, and surgical duration enhance the internal validity and practical applicability of the findings.

6. Conclusion

In conclusion, this study demonstrated that both WALANT and regional anesthesia are safe and effective options for distal radius fracture surgery, with comparable outcomes for postoperative pain, hemoglobin drop, and CRPS incidence. While WALANT was associated with a higher volume of intraoperative bleeding, it offered the advantage of significantly shorter surgical duration and eliminated the need for a tourniquet. These findings support the clinical viability of WALANT as an efficient alternative to regional anesthesia, particularly in settings where minimizing equipment use and optimizing surgical time are priorities. Further randomized studies with larger sample sizes and longer follow-up are warranted to confirm these results and explore long-term functional outcomes.

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Availability of data and materials: Information on where data supporting the results reported in the article can be found and made available by the corresponding author.

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Consent for publication: Not applicable.

Ethics approval and consent to participate: All procedures performed in this study involving human participants were by the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards and were approved by the Research Ethics Committee of the Faculty of Medicine, Shahid Beheshti University of Medical Sciences. (approval code: IR.SBMU.MSP.REC.1403.567).The study's objectives and procedures were clearly explained to all participants, and written informed consent was obtained.

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Data analysis: Mehrdad Sadighi, Mohammad Akhbari Final approval of the version to be submitted: Meisam Jafari Kafiabadi, Babak Toloue Ghamari, Adel Ebrahimpour.

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