

RESEARCH ARTICLE

Does Removal Of Volar Locking Plate Affect Patient Functional Outcomes?

Enver Kilic,¹ Mehmet Fatih Savas¹.

¹Department of Orthopaedic Surgery, Ministry of Health Ankara City Hospital, Turkiye

Abstract

Introduction: The aim of our study is to evaluate the effect of volar locking plate (VLP) removal on functional scores.

Methods: In this retrospective study, between January 2019 and January 2024, medical records of our institution were reviewed and patients who underwent VLP removal were included in the study. Demographic characteristics of the patients, follow-up time until VLP removal and reasons of VLP removal were evaluated from medical records. Preoperative and postoperative 3rd month Disabilities of Arm, Shoulder and Hand (DASH) scores were evaluated. Soong classification was performed on lateral wrist radiographs.

Results: Thirty-eight patients (24 male, 14 female) patients were included in the study. The mean age of all patients was 51.23±15.6 years. The mean time from VLP fixation to implant removal was 17.42±12.42 months. Patients who underwent implant removal were evaluated according to the Soong classification. 18 of the patients (%47.36) were grade 0, 16 of the patients (%42.1) were grade 1 and 4 of the patients (%10.54) were grade 2. The most common removal reason was patient request (n=26, %68.42). Preoperative mean DASH score was 19.1 and postoperative 3rd month mean DASH score was 8.2. There was a significant difference between preoperative and postoperative 3rd month DASH scores. (p<0.001) When patients were asked whether they would choose to implant removed again if they were in the same situation, %94.7 of the patients stated that they would choose implant removal again.compared to those with only one previous cesarean section (p=0.015).

Conclusion: VLP removal provided significant improvement in the patients' functional outcomes. The most common reason for VLP removal was patient request.

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ORCID's of the authors:

EK : 0000-0001-5475-8966

MFS:0009-0008-6475-0763

Correspondence Address: Üniversiteler Mahallesi 1604. Cadde No: 9 Çankaya Ankara - Türkiye

Phone: +90 505 206 28 18 / **e-mail:** enverkilic@gmail.com

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Introduction

Distal radius fractures (DRF) are one of the most common fracture in adults.¹ The incidence of DRF in the adult population is higher in women. However, the incidence of DRF in adolescents is higher in males.^{2,3} The most common cause of trauma in the elderly population is falling from standing height and osteoporosis is the most important risk factor.⁴ And the prevalence of DRF will continue to rise as the elderly population increases.^{5,6}

Although the trend in the treatment of DRF is towards surgery, the most frequently applied treatment methods are non-operative methods.^{7,8} With the development of volar locking plates (VLP), the number of surgically treated DRFs has increased. 16% of all fractures requiring orthopedic surgical treatment are DRF.⁹ The advantages of VLP are more stable fixation, shorter immobilization period and fewer complications.^{10,11} However, tendon irritation, nerve irritation or infection may develop after VLP fixation.¹²⁻¹⁴

If there are no complications, most surgeons do not require VPL removal.^{15,16} A wide range of VLP removal rates have been reported in different studies.^{17,18} Although satisfactory results have been reported in the surgical treatment of DRF with VLP, VLP removal is required in some cases.¹⁹⁻²¹ Main reasons of VLP removal are pain, tendon rupture, malunion, infection, nonunion, tenosynovitis and tendon rupture.²² Reasons for VLP removal include patient request and surgeon discretion, in addition to complications.²³ Soong et al developed a classification system to determine the risk of tendon rupture after VLP treatment.²⁴ In our study, we aimed to evaluate the effect of VLP removal on functional scores.

Material and Methods

Approval for the study was granted by the institutional review board of the authors' affiliated institutions (Project number: TABED 1-24-186, date: 08.05.2024). All the researchers who participated in the study signed the most recent version of the Helsinki Declaration. All patients signed an informed consent form.

In this retrospective study, between January 2019 and January 2024, medical records of our institution were reviewed and patients who underwent VLP removal were included in the study. Patients over 18 years were included in the study. Patients requiring additional fixation material, patients treated with any material other than VLP, patients with bilateral DRF,

neurovascular injury, multiple trauma, pathological fracture, previous DRF and patients with insufficient medical records were excluded from the study. Demographic characteristics of the patients, follow-up time until VLP removal and reasons of VLP removal were evaluated from medical records.

All VLP removals were performed under anesthesia. (general anesthesia or nerve block) And modified henry approach was used. (Figure 1) Tourniquet was used for all surgeries. After VLP removal, range of motion (ROM) exercises were allowed immediately. Preoperative and postoperative 3rd month Disabilities of Arm, Shoulder and Hand (DASH) scores were evaluated.



Figure 1: Preoperative and postoperative radiography of volar locking plate removal

The PACS system was used for radiological evaluations. And Soong classification was performed on lateral wrist radiographs. Soong et al developed a classification system based on the prominence of the volar plate. In the Soong classification, a line is drawn parallel to the volar cortex, starting from the volar rim of the radius. If the volar plate is proximal to the line, it is called grade 0. If the volar plate is at the same level as the line, it is called grade 1. And if the volar plate is distal to the line, it is called grade 2. (Figure 2)



Figure 2: Soong classification

Statistical analysis:

Statistical data analyses were performed using SPSS 22.0 software (SPSS Inc., Chicago, IL, USA). Categorical variables were compared using the chi-square test. The suitability of continuous variables to normal distribution was examined by calculating skewness and kurtosis values. Continuous variables with normal distribution were compared using the independent samples t test, and continuous variables with non-normal distribution were compared using the Mann-Whitney U test. Measurements taken before and after the surgery were analyzed using the dependent sample t test. The results were evaluated within 95% confidence intervals, and $P < 0.05$ was considered significant.

Results

Between January 2019 and January 2024, 44 volar plate removal were performed. Six patients did not meet the inclusion criteria and they were excluded from the study. Thirty-eight patients (24 male, 14 female) patients were included in the study. The

mean age of all patients was 51.23 ± 15.6 years. The mean age of female patients was 50.64 ± 15.75 years and the mean age for male was 51.58 ± 14.83 years. Eighteen of the patients (10 male, 8 female) dominant side was operated. The mean time from VLP fixation to implant removal was 17.42 ± 12.42 months. Implant removal of 29 patients was performed within the first 2 years. (Table 1)

Table 1: Characteristics of Patients

	Female (n=14)	Male (n=24)	All patients (n=38)
Age	44.92±15.6	51.58±14.83	51.23±15.6
Side	8 left, 6 right	12 left, 12 right	20 left, 18 right
Dominant side	8	10	18
Mean time from VLP fixation to implant removal	16.49±11.89	17.96±13.27	17.42±12.42
Implant removal in first 2 years	14	15	29

Patients who underwent implant removal were evaluated according to the Soong classification. 18 of the patients (%47.36) were grade 0, 16 of the patients (%42.1) were grade 1 and 4 of the patients (%10.54) were grade 2.

The reasons of implant removal were evaluated. And the most common reason was patient request (n=26, %68.42). The other reasons were carpal tunnel syndrome (n=2, %5.26), screw joint penetration (n=1, %2.64), pain (n=4, %10.53), foreign body sensation (n=1, %2.63), stiffness (n=2, %5.26) and cold intolerance (n=2, %5.26). Median nerve decompression was performed for the patients with carpal tunnel syndrome in the same session.

Clinical outcomes were evaluated with DASH score. Preoperative mean DASH score was 19.1 and postoperative 3rd month mean DASH score was 8.2. There was a significant difference between preoperative and postoperative 3rd month DASH scores. ($p < 0.001$)

After implant removal only 2 minor complications were reported. One patient had superficial infection and one patient had numbness on the incision. Superficial infection was treated with oral antibiotics. And numbness on the incision resolved within 6 months.

When patients were asked whether they would choose to implant removed again if they were in the same situation, %94.7 of the patients stated that they would choose implant removal again.

Discussion

In the current study, we determined that VLP removal provided significant improvement in the patients' functional outcomes. The most common reason for VLP removal was patient request, and almost 90% of the patients who underwent implant removal were grade 0 or 1 according to the Soong classification.

There are studies in the literature indicating different implant removal rates between 0% and 100% after distal radius fracture fixation.¹⁷ While some surgeons perform routine implant removal, some surgeons perform implant removal due to patient request or complications. Palola et al. determined that plate removal rates were over 20% between 1998 and 2004, but it decreased to less than 13% after 2008.²⁵ The reason of the implant removal rate decrease was attributed to improvements in plate design and increase in surgical experience. Yamamoto et al. reported that increase of the rate of implant removal is associated with the increase of the complication rate.¹⁷ In our study, we performed implant removal due to patient request and complications. In previous studies, the most common reason for implant removal was pain.²⁷ In the current study, patient request was the most common reason for implant removal and the second most common reason was pain.

There are different reasons for VLP removal like infection, tendon irritation, tendon rupture, neurovascular injury, nerve irritation, non-union and malunion. However, some patients want implant removal without any clinical symptoms. Removals performed without symptoms are called routine removals.¹⁷ In many studies, the most common reason for removal is routine removal. Lee et al. reported that in their study routine removals accounted for %73.8 of all removals.²⁹ In our study, routine removal was %68.42.

Flexor tendon irritation may develop due to distally plate placement, especially in joint-related and comminuted fractures. A higher rate of implant removal is expected in patients with more distal VLP placement. However, no difference was reported in the implant removal rates of joint-related and comminuted fractures.¹⁷ Therefore, we did not evaluate the fracture types separately in our study.

According to the Soong classification, most cases with grade 2 result in implant removal.²⁶ Selles et al. reported that patients with grade 2 Soong clas-

sification underwent 6 times more implant removal than patients with grade 0.²⁶ In our study, we evaluated only patients who underwent VLP removal. Therefore, we could not give implant removal rates according to Soong classification. However, in line with the literature, the majority of patients who underwent implant removal were grade 0 or 1 according to Soong classification.²⁹

Different studies have reported improvement in functional outcomes with implant removal after distal radius fracture fixation.²² Lee et al. determined significant improvement between preoperative and postoperative DASH scores.²⁹ In the current study, DASH score improved from 19.1 to 8.2. A significant improvement in functional results was observed in patients who underwent routine removal, as well as in symptomatic patients. The increase in functional score with routine removal raises the question of whether implant removal should be performed in all suitable patients. However, this question can be answered with larger studies.

Various complications may develop with implant removal like infection, refracture, nerve injury and tendon injury. Additionally, locking plate designs may cause difficulties in implant removal.³⁰ We encountered 2 minor complications in our study. One patient had superficial infection and one patient had numbness on the incision. Superficial infection was treated with oral antibiotics. And numbness on the incision resolved within 6 months.

Our study have some limitations. Firstly, different types of VLP removed. But they were not evaluated separately. Secondly, only functional outcomes of the patients who underwent implant removal were evaluated. We did not have implant retention group. Thirdly, the fracture patterns of the patients included in the study were not evaluated separately. Different fracture types may affect functional outcomes. More valuable data can be obtained with larger patient groups.

Conclusion

VLP removal provided significant improvement in the patients' functional outcomes. The most common reason for VLP removal was patient request.

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