

TREATMENT OF MIDSHAFT CLAVICLE FRACTURE WITH SUPERIOR PLATE PLACEMENT

TRATAMENTO PARA FRATURA DA DIÁFISE DA CLAVÍCULA COM INSERÇÃO DE PLACA ÓSSEA SUPERIOR

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ABSTRACT

Objective: To evaluate the late clinical and radiological results of patients had locking plate anatomically compatible from superior surface and muscle cover on plate due to clavicle mid-region. **Materials and Methods:** Forty patients were included retrospectively. Patients had a routine right shoulder anterior posterior graph after examination. The results were assessed by returning to the patient's daily activities, Constant score, the Disability of the Arm, and Shoulder and Hand scoring, followed by radiological and clinical examination. **Results:** Fourteen (35%) patients were female and 26 (65%) were male. The mean age was 36.2 years. Twenty-six patients had right clavicle fracture and 14 patients had left. Twenty-three fractures were type 2B1 and 17 fractures were type 2B2. Mean follow-up time was 36.4 months. Radiologic union was at a mean of 9.1 ± 1.3 weeks. All patients had excellent results. The mean Constant score was 97.2 ± 1.8 , the mean Disability of the Arm, and Shoulder and Hand score was 3.8 ± 2.4 . **Conclusion:** It is possible to obtain complete union with high patient satisfaction by avoiding the complications and difficulties of the conservative treatment with the use of the anatomically compatible locking plates in superior fixation and our surgical dissection. **Level of Evidence III, Retrospective Case controlled study.**

Keywords: Clavicle. Midshaft Clavicle Fracture. Osteosynthesis. Plate Fixation. Superior Placement.

RESUMO

Objetivo: Avaliar os resultados clínicos e radiológicos tardios dos pacientes com placa óssea de trava anatomicamente compatível com a superfície superior e a cobertura muscular na placa devido à região média da clavícula. **Materiais e Métodos:** Quarenta pacientes foram incluídos retrospectivamente. Os pacientes apresentaram um gráfico ântero-posterior de rotina do ombro direito após o exame. Os resultados foram avaliados retornando às atividades diárias do paciente, escore de Constant, incapacidade do braço e escores de ombro e mão, seguidos de exame clínico e radiológico. **Resultados:** Quatorze (35%) pacientes eram do sexo feminino e 26 (65%) do sexo masculino. A idade média foi de 36,2 anos. Vinte e seis pacientes tiveram fratura da clavícula direita e 14 pacientes saíram. Vinte e três fraturas foram do tipo 2B1 e 17 fraturas do tipo 2B2. O tempo médio de acompanhamento foi de 36,4 meses. A união radiológica foi em média de $9,1 \pm 1,3$ semanas. Todos os pacientes tiveram excelentes resultados. A pontuação média constante foi de $97,2 \pm 1,8$, a média de incapacidade do braço e a pontuação do ombro e da mão foi de $3,8 \pm 2,4$. **Conclusão:** É possível obter união completa com alta satisfação do paciente, evitando as complicações e dificuldades do tratamento conservador com o uso das placas ósseas de trava anatomicamente compatíveis na fixação superior e na nossa dissecação cirúrgica. **Nível de evidência III, Estudo retrospectivo controlado por caso.**

Descritores: Clavícula. Fratura de Clavícula de Eixo Intermediário. Fixação de Placas Ósseas. Colocação Superior.

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INTRODUCTION

Clavicle fracture is a common fracture and constitutes approximately 4% of all fractures in adults.¹ The location of the clavicle fracture is approximately 75% clavicular and 1/3 middle part due to its thin form and direct contact with the skin. Clavicular injuries can lead to abnormal biomechanical stresses and long-term disability along the pectoral girdle.^{2,3}

Conservative treatment and open reduction and plate fixation are used in the treatment of the currently displaced midshaft clavicle fractures. Conservative treatment was reported to have a higher union rate than open reduction and plate fixation.⁴ However, patients treated with open reduction and plate fixation have a better outcome than conservative treatments according to functional scores.⁵ Despite the reduced pain and improved

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functional recovery in patients with displaced midclavicular fractures treated with open reduction and plate fixation,^{6,7} infection due to the graft of a large soft tissue can lead to complications such as numbness on the skin, nonunion, delayed union, and enlarged scar tissue.⁸⁻¹⁰

Treatment of these fractures with open reduction and internal fixation preserves from nonunion, symptomatic malunion, shortening and deformity. Studies have shown that the superior plate is biomechanically better than the anterior plate and that the locked screws are better than the unlocked ones.¹¹⁻¹³ But superior resident plates are usually palpable under the skin and can cause skin irritation.¹⁴⁻¹⁹

In this study, we sought to evaluate the late clinical and radiological results of patients who underwent locking plate fixation anatomically compatible in the superior surface and muscle cover on plate due to the mid-region of the clavicle.

METHODS

Forty patients who underwent surgery between May 2009 and September 2016 with mid-diaphyseal clavicle fracture were included retrospectively in our study. All patients participating in the study signed an informed consent form. The study was conducted in agreement with the Declaration of Helsinki. Approval for our study was obtained from the institutional review board. Our study is in line with the STROCSS criteria. Displacement or shortness of more than 20 mm in patients with segmental fractures with multiple fractures or disintegration, as well as conservative treatment intolerance were indicated for surgical treatment. The study included only patients with isolated mid-diaphyseal clavicle fractures.²⁰ Patients with pathologic fractures, open fractures, those with neurovascular injuries and/ or 2-week fractures were excluded. All patients had chest radiography to exclude possible cote and scapular injury. After diagnosis, patients were prepared for surgery by applying a shoulder-arm sling.

All patients were assessed with a routine right-shoulder anterior-posterior graph after a detailed physical examination. During the follow-up period, the results were clinically assessed by the patient's return to daily activities, Constant score, the Disability of the Arm, and Shoulder and Hand scoring, followed by radiological and clinical examination of the fracture union.

Surgical Technique

Patients were prepared for operation in beach-chair position under general or regional anesthesia. Skin incision was made approximately 1 cm below the clavicle lower level (infraclavicular incision). The subcutaneous tissue was prepared without dissecting, and the preparation of skin-subcutaneous and platysma muscle together in a flap style, clavicle anterior and superior sides were elevated by approaching to proximal. Thus, the clavipectoral fascia was scrapped over the clavicle to the extent that was required and the fraction was reduced by avoiding an aggressive dissection. Temporary detection with K-wires was performed when necessary. In the case of the butterfly fragment, these fragments were temporarily attached to the main part with absorbable sutures (Vicryl no: 0). Rigid fixation by applying a 3.5 mm locking screw (LCP Superior Anterior Clavicle Plate) and a preformed clavicle plate with a low contact surface were performed for the all patients. At the end of the operation, clavipectoral fascia was repaired to cover the plate. Flap prepared initially from skin-subcutaneous and muscle, was completely closed on the plate in such a way that it was completely muscular (Figure 1).

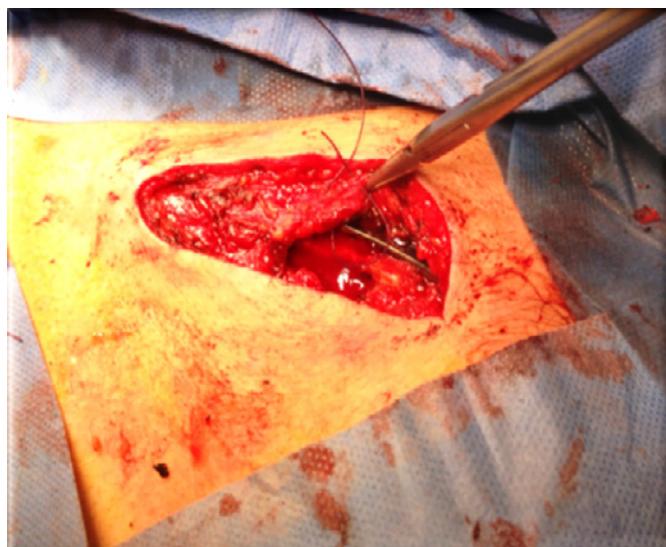


Figure 1. Muscular flap.

Post-operative protocol

Shoulder pendular exercises were started for patients on the first day after the surgery. Antibiotic prophylaxis continued for 2 days after the operation. Surgical wound was checked on the 3rd day, and the patients were discharged with arm sling. Patients were called for control at 4, 8 and 12 weeks postoperatively. In the fourth week, exercises of the shoulder joint movement were started when the use of the arm sling were interrupted. The radiologic examinations required to evaluate the postoperative fracture were examined by an orthopedic surgeon and a radiologist blinded for the study. Radiographically, more than 50% of the fracture lines were classified as complete union. Union was assessed by bone bridge formation between fracture fragments, sensitivity on the fracture line and clinical examination of the shoulder joint movements. The delayed union was determined by the initial radiologic callus formation that was seen after 24 weeks, and the nonunion was determined by the absence of callus and pathological movement after 24 weeks.²¹ Shoulder strengthening exercises have been initiated for patients that had union symptoms. Contact sports were allowed three months after the surgery.

NCSS 2007 version software (Number Cruncher Statistical System – Kaysville, Utah, USA) was used for the statistical analysis. While evaluating the data from the study, apart from using descriptive statistical methods (Mean, Standard Deviation, Median, Frequency, Rate, Minimum, Maximum), Mann Whitney U test was used for the two group comparison for the parameters with abnormal distribution. Fisher-Freeman-Halton test, Fisher's Exact test and Yates' Continuity Correction test (Yates' correction chi square) were used to compare qualitative data. Wilcoxon Signed Ranks test was used for intra-group comparisons of abnormal parameters. Significance was evaluated considering $p < 0.05$.

RESULTS

In total, 14 patients (35%) were women and 26 were men (65%). The mean age of the patients participating in the study was 36.2 (range: 22-59). Twenty-six patients had clavicle fracture on the right side and 14 patients, on the left side. According to Robinson's classification, 23 fractures were type 2B1 and 17 fractures were type 2B2. Mean

method for detecting axial fracture of superior plate in the detection of midshaft clavicle fractures. In the same study, no difference was found between torsional forces and resistance among all three types of plate fixation.³⁵

Our study has some limitations. First, the study retrospective design was the main limitation, and we also included patients with wide range of age distribution. However, we included similar type of fracture and treated our patients with the same method. Our study may guide further studies on the evaluation of the superior plating treatment due to the clinical outcomes found.

We believe we have achieved excellent results with our study on the fixation of the fracture with our superior plate fixation technique

and with an early rehabilitation program applied to all patients. Furthermore, we think that we can minimize the plate prominence risk by providing the muscle flap and plate covering that we used during the surgical approach and adapt the patients to the rehabilitation period, minimizing the complaints of skin irritation in later periods.

CONCLUSION

Complications such as shortening and excessive callus formation can be observed as a result of disintegrated or multi-part midshaft clavicle fractures. It is possible to obtain complete union with high patient satisfaction by avoiding the complications with anatomically compatible locking plates in superior fixation and our surgical dissection.

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. BEK: substantial contributions to the conception and design of the study; YO: data acquisition, analysis, and interpretation; REE: final approval of the version to be published and accountability for all aspects of the study, ensuring that questions related to the accuracy or integrity of any part of the article are appropriately investigated and resolved.

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