Impact of One Year COVID-19 on Hand and Upper Extremity Injury: A Cross-Sectional Study

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ABSTRACT

Background: On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a worldwide pandemic. On March 31, 2020, Indonesia enacted a large-scale societal limitation. As a result, the number of patients seeking medical treatment for emergencies has decreased significantly. Home and fall accidents were the leading causes of a hand injuries, and this trend is anticipated to persist throughout the epidemic. Despite this, there is scarce information about the many forms and causes of hand and upper extremity injuries. This research aimed to see how COVID-19 affected hand and upper extremity injuries.

Methods: The observational cross-sectional research was undertaken from March 2019 to February 2021. The Pre-COVID-19 phase was measured from March 2019 to February 2020, while the COVID-19 period was measured from March 2020 to February 2021. Patients who presented to Prof. Dr. R. Soeharso Orthopedic Hospital with hand and upper and lower extremity injury-related diagnoses from the emergency unit, outpatient, or inpatient were included in the study.

Results: The overall number of patients in this study was 2644, with a mean total number of patients of 141.83 (SD 43.21) in the pre-COVID-19 era and 78.5 (SD 32.55) in the COVID-19 era, a significant reduction (p < 0.001).

Conclusion: There is a substantial drop in hand and upper extremity injury patients during the timespan of COVID-19 compared to the Pre-COVID-19. The findings might aid in the development of new ways for better understanding the service provisions needed in the case of injury during a pandemic.

Keywords: COVID-19; Upper extremity; Injury; Cross-sectional study; Human and medicine

INTRODUCTION

Coronavirus disease-2019 (COVID-19) is an infectious illness caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV2), affecting systemic and respiratory problems. On March 11, 2020, the World Health Organization (WHO) confirmed the COVID-19 outbreak was a worldwide pandemic. COVID-19 has been linked to about 76 million reported cases and 1.6 million deaths as of December 21, 2020. According to data collected in Indonesia around the middle of December 2021, there are over 600,000 confirmed cases. The large-scale social restriction was implemented in Indonesia on March 31, 2021.

This restriction was a preventive policy to combat COVID-19 spread in some Indonesian areas. Only public places, such as grocery stores, gas stations, and hospitals, were left open, restricted non-essential activities. During this pandemic, all public health services had dynamic changes. As a result, the number of patients seeking medical assistance for emergencies has decreased significantly. In developing countries,
hand injuries accounted for a high percentage of trauma situations. Home and fall accidents were the dominant causes of hand injuries, and this trend is predicted to persist throughout the epidemic.6

Despite this, there is scarce information about the many forms and causes of hand and upper extremity injuries. Changes in behavior and habits during the pandemic will indirectly provide differences in activity patterns and shift the etiological causes that have the most potential to cause injury. The purpose of this research was to examine how the COVID-19 pandemic era with protocol in all activities influenced injuries to the hands and upper extremities, including the incidence of injury, the most common etiology of all cases of injury, and length of hospital stay.

MATERIAL AND METHODS

This cross-sectional research compared the population group in Indonesia during the COVID-19 pandemic to the same time frame a year prior. This research took place in Surakarta, Indonesia, at the Prof. Dr. R. Soeharso National Referral Orthopaedic Hospital. The research lasted three months, from February to April 2021.

Digital medical records provided the data for this investigation. Beginning with the initial months after the Indonesian government declared the initial COVID-19 case (March 2020 – February 2021), anonymized data was collected for a year. The control duration (March 2019 – February 2020) was one year before the COVID-19 pandemic. Predefined characteristics collected were dates, age, sex, primary and secondary conditions, surgical treatment, etiology, doctor, and installation. The ICD-10 system was used to classify diagnoses and treatments.

This study covered all patients presented to Prof. Dr. R. Soeharso Orthopedic Hospital with diagnoses relating to hand and upper and lower extremity injuries in the emergency room, outpatient clinic, or inpatient setting. Patients enrolled in supporting facilities, such as lab, radiography, physiotherapy, were exempt.

Following ethics approval, data were extracted from Prof. Dr. R. Soeharso Orthopedic Hospital’s medical records using inclusion and exclusion criteria. Inclusion criteria included all hand and upper extremity injury patients who underwent inpatient or outpatient treatment. Patients’ age was divided into 3 categories, namely <18 years, 18 - 64 years, and ≥ 65 years. The data were then categorized based on the above-predefined characteristics. The research results worksheet was used to keep track of the data monthly. To compare the data, statistical analysis was used. Different conditions were compared before and after the pandemic. During the pandemic, the difference between different time points (Months) was also measured.

The statistical data were assessed using the independent sample t-test or the Mann Whitney U-test. IBM’s Statistical Package for the Social Sciences (SPSS) version 26.0 was operated to conduct the research. The findings were judged statistically significant if the difference in total instances between the two classes was less than 0.05. The same approach examined variations in sex, ages, charge, admission, duration of stay, operation cause, and injury site.

RESULTS

About 2644 participants were joined in this trial. During the pre-COVID-19 timespan, the mean number of hand and upper extremity injuries was 141.83 (SD 43.21) patients. In contrast, during the COVID-19 period, the mean number of hand and upper extremities injuries was 78.5 (SD 32.55) patients. A significant decrease of patients visit is recorded in 1 year of pandemic, compared to the same timespan in 2019 (p < 0.05). With 24 visits in April, the lowest number of patients visited. Figure 1 shows the visitors number per month.

We also looked at how COVID-19 affected patient sex, age, payment, duration of stay,
admission, surgical etiology, and injury location. Except for the patient’s length of stay (p = 0.773), work-related accident (p = 0.136), and fracture phalanx (p = 0.087), we detected a significant decrease (p < 0.05) in all variables in Table 1.

**DISCUSSION**

Our findings demonstrate a significant drop in total patients during the COVID-19 era compared to the pre-COVID-19 period (p = 0.001). A decline also followed this in the total number of sex, age, and payment method data. These results concordance with research that reported that there had been a significant decline in patient admissions with hand injuries in France since the pandemic of COVID-19. This finding is probably due to the Indonesian government’s large-scale social restriction policy, which started on March 31, 2020, resulting in decreased mobility, one of the risk factors for accidents. Another plausible explanation for the reduction of the admission was the patient's fear of contagion, leading to death.

Patient length of stay did not show any significant changes (p = 0.773) during the pan-

**Table 1.** The total number of hand and upper extremity injuries during COVID-19 compared to Pre-COVID-19.

<table>
<thead>
<tr>
<th></th>
<th>Pre-COVID-19 Mean±SD</th>
<th>COVID-19 Mean ±SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Patients</td>
<td>141.83±43.21</td>
<td>78.5±32.55</td>
<td>0.001*</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>86.83±28.03</td>
<td>52.67±21.09</td>
<td>0.003*</td>
</tr>
<tr>
<td>Female</td>
<td>55±17.02</td>
<td>25.83±12.63</td>
<td>0.00009*</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;18 years old</td>
<td>39.17±12.87</td>
<td>23.75±10.34</td>
<td>0.004*</td>
</tr>
<tr>
<td>18-64 years old</td>
<td>92.17±30.81</td>
<td>49±21.04</td>
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</tr>
<tr>
<td>≥65 years old</td>
<td>10.5±4.93</td>
<td>5.75±2.67</td>
<td>0.008*</td>
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<tr>
<td>Payment</td>
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<tr>
<td>Public</td>
<td>56.75±19.68</td>
<td>25.17±9.67</td>
<td>0.0001*</td>
</tr>
<tr>
<td>Insurance</td>
<td>85.08±27.88</td>
<td>53.33±26.11</td>
<td>0.009*</td>
</tr>
<tr>
<td>Length of Stay (days)</td>
<td>2.58±0.31</td>
<td>2.54±0.34</td>
<td>0.773</td>
</tr>
<tr>
<td>Admission</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>65.17±11.01</td>
<td>38.25±12.31</td>
<td>0.00001*</td>
</tr>
<tr>
<td>Outpatient</td>
<td>75.92±35.34</td>
<td>40.08±23.83</td>
<td>0.008*</td>
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<tr>
<td>Surgery etiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport Accident</td>
<td>30.83±5.61</td>
<td>15.17±6.16</td>
<td>0.0001*</td>
</tr>
<tr>
<td>Home Accident</td>
<td>17.17±5.18</td>
<td>13±4.35</td>
<td>0.044*</td>
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<td>Work-related Accident</td>
<td>1.08±0.9</td>
<td>0.58±9.00</td>
<td>0.136</td>
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<td>Location of injury</td>
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<tr>
<td>Fracture Phalanx</td>
<td>6.58±3.42</td>
<td>4.33±2.67</td>
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<tr>
<td>Fracture Metacarpal</td>
<td>5.42±2.27</td>
<td>3.00±1.81</td>
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<tr>
<td>Fracture Radius</td>
<td>25.5±7.32</td>
<td>13.42±9.41</td>
<td>0.003*</td>
</tr>
<tr>
<td>Fracture Ulna</td>
<td>11.67±7.48</td>
<td>5.2±3.77</td>
<td>0.018*</td>
</tr>
<tr>
<td>Fracture Humerus</td>
<td>32.33±10.87</td>
<td>17.67±7.48</td>
<td>0.001</td>
</tr>
</tbody>
</table>
demic period. This result was similar to a research held by Atia et al., which stated insignificant changes \( (p = 0.059) \). This could be happening because the characteristics of the disease were quite similar between the two periods. Outpatient and surgery decreased significantly. There was also a significant decrease in transport and home accidents in the surgery etiology group. This result was linear with research by Wong et al. which stated a significant decrease in traffic-related and domestic-related trauma about orthopedic accidents during COVID-19. Insignificant changes are shown in a work-related accident because the data was very little \( (\text{Pre-COVID-19 mean } 1.08 \pm 0.9 \text{ and } \text{COVID-19 mean } 0.58 \pm 0.9) \). All data on the location of injury, such as metacarpal \( (p = 0.009) \), radius \( (p = 0.003) \), ulna \( (p = 0.018) \), and humerus \( (p = 0.001) \) showed significant differences, except for the phalanx \( (p = 0.087) \).

In conclusion, most of the data showed significant differences in total hand and upper extremity injury during the COVID-19 period compared to the Pre-COVID-19 period. The results were necessary to prepare for the needs in hand surgery for a potential forthcoming identical health situation.

**CONCLUSION**

There is a considerable drop in the number of hands and upper extremity injury patients at COVID-19 compared to the Pre-COVID-19 time-span. The findings could aid in developing new approaches for better understanding the service provisions needed in the case of a pandemic.

**REFERENCES**

The Effect of Culture Techniques of Hypoxic Stem Cell Secretome on The Number of Growth Factor TGF-β, BMP-2, VEGF

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ABSTRACT

Background: Mesenchymal stem / stromal cell therapy (MSCs) is now an effective therapeutic modality for treating various diseases. In its application, stem cells require signaling molecules which can be growth factors, cytokines, or chemokines. Signal molecules work orderly and are greatly influenced by the physiological environment. Stem cell culture techniques with hypoxic conditions can produce growth factors close to physiological conditions in fractures. This study aims to perceive the different expressions of some growth factors in cultured normoxic and hypoxic BMSC.

Methods: This study is an in vitro laboratory experimental study of normoxic Bone Marrow Stem Cells (BMSCs) and Hypoxic Bone Marrow Stem Cells (BMSCs) cultures. The BMSCs experimental unit was taken from rabbits and then propagated in vitro and cultured under two conditions, normoxia and hypoxia. Then the number of VEGF, TGF-β, BMP-2 growth fractures was observed using ELISA.

Results: VEGF, TGF-β, and BMP-2 expressions showed significant differences between the normoxia and hypoxia groups. VEGF, TGF-β, and BMP-2 expression were higher in the hypoxia group compared with the normoxia group (p < 0.05).

Conclusion: The expression analysis of TGFβ-1, VEGF, and BMP-2 growth factors in cultured BMSC were statistically significant between normoxic and hypoxic conditions. TGFβ-1, VEGF, and BMP-2 expressions increase in hypoxic conditions.

Keywords: Hypoxic secretome; VEGF; TGF-β; BMP-2; Human and medicine

INTRODUCTION

Stem cell therapy/mesenchymal stem cell (MSCs) is an effective therapeutic modality for treating various diseases because of tissue’s protective and reparative mechanisms.1,2 In its development, stem cell therapy has been widely used in various fields of medical science, including orthopedics. A further understanding of bone healing and stem cells provides many opportunities for applying stem cell therapy in orthopedic cases, especially the fracture healing process.

Bone healing is divided into two, primary healing and secondary healing. Primary healing will develop with minimal callus appearance in installing rigid fixation and good contact between fractures. This process occurs because of the fracture area’s low strain, thus forming new blood vessels through the Haversian system. Damaged bone will be resorption by osteoclasts and filled by osteoblasts as in a homeostatic process occurs in bone infection, bone tumors, and avascular necrosis.3-5 In the fixation technique, which is relatively stable, a secondary healing process will occur through the withdrawal of stem cells that will receive the signal from growth factors (TGF-β, GDF-5, BMPs) to create cartilage which will later become an adequate bone structure and undergo remodeling. Most fractures healed by primary and secondary
MATERIAL AND METHODS

This research is an experimental laboratory study in vitro of normoxic Bone Marrow Stem Cells (BMSCs) and hypoxic Bone Marrow Stem Cells (BMSCs) cultures with Randomized Control Post Test-Only Group Design. This research was conducted for three months at the Institute of Tropical Disease (ITD) and the Tissue Bank in our institution. The ethical committee in our institution has approved this study with certificate number 2.KE.129.07.2019. This study used 1 set of hypoxic chambers, a Class III Biological Safety Cabinet (BSC), a centrifuge equipped with a brake button, an incubator with 5% CO$_2$ humidity and 37°C temperature, and an inverted phase-contrast microscope super long working distance condenser (SLWDC). As for the research materials used for isolation reagents: -MEM with 1-glutamine; Fetal Bovine Serum (FBS) (Biowest, Cat. S1650); 1 Glutamine, 200 mM (nitrogen), solution used for isolation: Complete Culture Medium (CCM): 500 mL -MEM; 100 mL FBS (Final concentration ~16.5%: 6 mL 1-glutamine (final concentration 2 mM) and reagent for culture: low glucose -MEM (Sigma, Cat. M0894); 50 ml Fetal Calf Serum (FCS) selected for MSCs (Gibco/Invitrogen).

The experimental unit BMSCs were taken from 1 healthy male rabbit then propagated in vitro into and divided into two groups: treatment group 1 (P1) Bone Marrow Stem Cells (BMSCs) normoxic culture; and treatment group 2 (P2) Bone Marrow Stem Cells (BMSCs) with hypoxic culture. The conditioning results of each group were observed for the number of growth factors VEGF, TGF-β, BMP-2. Observation of the number of growth factors VEGF, TGF-β, BMP-2. They were carried out using the ELISA test.

The implementation of this research was divided into three research stages: First, the isolation of BMSCs from the bone marrow of healthy male rabbit strains of New Zealand. Second, culture BMSCs on culture plates with two treat-
ments: normal oxygen and hypoxic conditions. We only used one level of hypoxic, which is 5%, because the venous blood contains about 5% oxygen. Third, analyze the number of growth factors after differentiation of stem cells in VEGF, TGF-1, and BMP-2. The data collected will be statistically analyzed using the SPSS 24 program.

RESULTS

Bone marrow samples were taken and then isolated for 10-14 days, and a flow cytometry test was performed for CD 105 and CD 45 to ensure that the preparations were stromal stem cells. Cells from the obtained BMSCs were grown until the fourth passage. Media replacement was done two times per week. BMSCs were separated from the media using 0.05% trypsin/0.53 mM EDTA and replated and rearranged at a density of 10 x 8 cells/cm² in the same culture medium as the first section. The culture was separated into two treatments in the next stage: culture under normoxia and hypoxia, and secretomes were taken from each group. The number of growth factors TGFβ-1, VEGF, and BMP-2 was calculated.

The mean value of VEGF expression in the hypoxic group was higher than that in the normoxia group, 2663.89 and 1577.88, respectively. In this study, there was a significant difference between the mean VEGF expression between the normoxia and hypoxia groups (p = 0.001).

In this study, there was a significant difference in the mean expression of TGF-β-1 between the normoxia and hypoxia groups (p = 0.000). The mean value of BMP-2 expression in the hypoxic group was higher than that in the normoxia group, 26969.84 and 16637.84, respectively. In this study, there was a significant difference between the mean BMP-2 expression between the normoxia and hypoxia groups (p = 0.003) (Table 1).

DISCUSSION

In the bone healing process, growth factors are produced and stimulated by Mesenchymal Stem Cells (MSCs) that migrate to the fracture area. Microenvironmental conditions in fractures tend to be hypoxic stimulate the formation of growth factors VEGF, TGF-β1, BMP-2 for the bone healing process through the callus formation phase (secondary bone healing) or the cutting cone mechanism (Primary bone healing) process.

Oxygen tension plays an important role in regulating the expression of various genes. One of them is VEGF mRNA expression induced by low pO₂ exposure in various pathological states. VEGF is the main target of transcription of Hypoxia-inducible Factor (HIF) through the VEGF receptor. This signaling helps heal tissue injury caused by hypoxic and inflammatory conditions. The result of this VEGF signaling is the occurrence of angiogenesis, increased blood flow, tissue perfusion, extravasation of inflammatory cells, remodeling, and tissue repair.

In this study, an increase in VEGF levels (2663.89 ng/L) in BM-

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VEGF</td>
<td>Normoxia 6</td>
<td>1577.88 ± 433.09</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>Hypoxia 6</td>
<td>2663.89 ± 385.65</td>
<td></td>
</tr>
<tr>
<td>TGF-β-1</td>
<td>Normoxia 6</td>
<td>37960.14 ± 1581.49</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Hypoxia 6</td>
<td>83545.14 ± 6317.08</td>
<td></td>
</tr>
<tr>
<td>BMP-2</td>
<td>Normoxia 6</td>
<td>16637.84 ± 711.91</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>Hypoxia 6</td>
<td>26969.84 ± 452.52</td>
<td></td>
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</table>

Table 1. Independent T-test analysis on the expression of TGFβ-1, VEGF, and BMP-2 between the normoxia and hypoxia treatment groups
SCs cultured under hypoxia compared to BMSCs cultured under normoxia was 1577.88 ng/L. In this study, an independent t-test was also carried out. A significant relationship was found on the amount of VEGF, namely an increase in hypoxic conditions rather than normoxia conditions. These results align with research conducted by Yin et al., where there was an increase in VEGF levels in the autopsy results of patients with Congenital Heart Disease (CHD). In contrast, there was a decrease in oxygen levels in the blood in patients with CHD. The research conducted by Lin et al. also showed similar results. An increase in VEGF levels was found in human Nasal Polyp Fibroblasts culture under hypoxic conditions induced by Cobalt Chloride (CoCl$_2$). TGF-$\beta$ is a multifunctional cytokine required for embryonic tissue development and adult tissue homeostasis. TGF-$\beta$ stimulates autocrine and paracrine structures important in maintaining and developing BMSCs. Bone and cartilage contain large amounts of TGF-$\beta$. TGF-$\beta$ stimulates osteoprogenitor proliferation, differentiation, and the formation of osteoblasts. In this study, the results showed a significant relationship to the amount of TGF-$\beta$, an increase in hypoxic conditions than normoxic conditions. Hypoxic conditions reported in several studies can stimulate TGF-$\beta$ in gastric cancer and increase the amount of TGF-$\beta$ in fibrous tissue. This is in line with a study conducted by Mingyuan et al., which found that the amount of TGF-$\beta$, both intracellular and secreted, was significantly higher in Human Foreskin Fibroblast (HFF) and Human Keloid Fibroblast (HKF) hypoxic conditions compared to those under normoxia.

Bone morphogenetic protein (BMPs) is a derivative of growth factor-$\beta$ and has a role in bone development and formation, tissue homeostasis, and tissue repair. BMPs and their derivatives are chondrogenic factors that stimulate cartilage tissue formation and matrix formation through chondrocyte cells. In this study, the concentration of BMP-2 was increased in BMSCs cultured under hypoxic conditions. The average concentration of BMP-2 under normoxia was 16637.84 ng/L, while it was 26969.84 ng/L in hypoxia. In addition, this study also performed an independent t-test and found a significant relationship with the amount of BMP-2. i.e., there is an increase in hypoxic conditions than normoxic. The increase of BMP-2 amount is in line with the research conducted by Tseng et al. that hypoxic conditions increase the expression of BMP-2 in osteoblasts through a HIF-1$\alpha$-dependent mechanism involving the activation of the ILK/Akt and mTOR pathways. Research conducted by Lafont et al. also showed similar results. There was an increase in the levels of BMP-2 and the products produced by BMP-2 under hypoxic conditions. Increased levels of BMP-2 were obtained through inhibition of the Smad pathway and activation of p38 MAPK.

**CONCLUSION**

Expression of TGF$\beta$-1, VEGF, and BMP-2 increased under hypoxic conditions. In addition, secretomes can be freeze-dried, so the storage of secretome would be easier and could facilitate doctors in health centers that do not yet have stem cells. In further research, hypoxia culture techniques can be used with the addition of Hydroxyapatite scaffold and Demineralized Bone Matrix to analyze the osteogenic secretome properties produced.

**REFERENCES**


Research Article

Better Functional Outcomes in Plate Fixation of Midshaft Clavicle Fracture in Dr. Soetomo Hospital

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ABSTRACT

Background: Clavicle fracture is one of the common fractures worldwide, which trends moved from conservative to operative treatment. This study evaluates functional outcomes between patients treated with plating and conservative in Dr. Soetomo, Hospital, Surabaya.

Methods: We found 531 cases with midshaft clavicle fracture that came to our ER from 1st January 2014 to 31st December 2018. Patients with a head injury, multiple traumas associated with neurovascular injury, history of re-fracture, malunion or nonunion, open fracture, and pathological fracture were excluded in this study. The final data was 161 patients to evaluate. A conservative group total of 84 patients was treated using an arm sling or figure of eight bandages, and an operative group of 77 patients performed ORIF with S-plate. Clinical and functional scores were evaluated retrospectively with a minimum of 6 months after treatment. Shoulder function evaluated using Shoulder Constant Score and Manual Muscle Test.

Results: We found that 117 (72.7%) patients were male with a mean age of 35.4 ± 12.33 years old. The right side was dominantly injured. The manual muscle test on the operative group was five, and the conservative group was four. The constant Shoulder group on the operative group was 93.38 ± 7.529, and the conservative group was 86.60 ± 7.560 (P<0.001), and DASH score on the operative group was 10.05±6.98 and the conservative group 23.67±3.49 (P<0.001).

Conclusion: In our study, surgery on clavicle midshaft fracture showed significant improvement and satisfaction in patients than conservative treatment. Patients gained better function in the outcome.

Keywords: Clavicle; Fracture; Operative procedure; Conservative treatment; Human and medicine

INTRODUCTION

Clavicle fracture had the highest incidence, accounting for 2.6-3% of all fractures. Cause of clavicle fracture mostly by a direct blow to the clavicle with the highest incidence in the second and third decade. A review by Cochrane comparing operative and conservative treatment in clavicle fracture by systematic review and meta-analysis found that operated patients with open reduction internal fixation (ORIF) gave union rate by 2.5% comparing an operative group. Malunion of clavicle gives little functional consequence. Many techniques showed a highhand injuries union rate and low complication rate in fixing clavicle fractures.1,2

A clavicle fracture is also possible to treat non-operatively. Clinical research should be objective information directed to encourage each injury, such as function and patient’s expectancy, fracture location, fracture type therapy based on this evaluation, and rational consideration of risk potency and benefit of the operation. Some recent studies showed the nonunion rate in midshaft clavicle ranges from 15-20%, loss of shoulder strength 18-33%, mild to moderate residual pain, and brachial plexus irritation.3,4 Some research also described functional and cosmetic deficits associated with malunion of the clavicle.5,6

The therapy goal in clavicle fracture is fewer complications and better functional outcomes. It has not been proven superior and is
not universally accepted. Return to function and avoidance of long-term complications are of socio-economic importance.\(^6\)

Some modern concepts, validation, responsiveness, consistency in measurement, are now available in evaluated shoulder girdle injury. A clinical study based on the anatomical area used patient-oriented measurement states, such as SF-36, patients' extremity specific results, such as Disability of Arm, Shoulder, and Hand (DASH), Constant Shoulder Score (CSS), and radiologic measurement. This study evaluates union rate and functional improvement in a patient with clavicle fracture comparing conservative treatment and operative treatment in Dr. Soetomo Hospital from January 1, 2014 to July 31, 2018. In conservative treatment, patients were given an arm sling or modified figure of eight bandages. As in operative treatment, superior S-plate osteosynthesis was selected because it provides less muscular stripping and better biomechanically.\(^4\)

**MATERIAL AND METHODS**

This retrospective study was performed at the Orthopaedic and Traumatology outpatient clinic, Dr. Soetomo Hospital, Surabaya. The ethical committee has already approved this study of our hospital. Patients are all informed and given informed consent. The study design was retrospective analytic observational. Using the hospital database, we identified 531 cases. Inclusion criteria were (1) new case < 14 days between fracture and treatment (2) aged 18-60 years old. Exclusion criteria are (1) multiple trauma, (2) multiple fractures, (3) assisted neurological or vascular injury, (4) open fracture, (5) bilateral clavicle fracture, and (6) pathological fracture. After excluding those cases, 100 patients were unable to contact or refused to participate in research, and a total of 161 cases were included in this research. Along with those patients, 84 patients were treated operative and 77 patients treated conservatively (Figure 1).

For all patients, we evaluated clinical examination along with standard anteroposterior and oblique clavicle radiograph and bilateral anteroposterior radiograph. Undisplaced midshaft clavicle fracture was prescribed for an arm sling. The displaced midshaft fracture was treated with modified eight bandages using stockinette and orthopedic padding wrapped across the shoulder and patient's back (Figure 2). The figure of eight bandages or arm sling was used for six weeks.

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**Figure 1.** Flowchart of inclusion in study design
with assisted active range of motion exercise as the pain was tolerated. After three weeks, patients were asked to perform pendulum exercises. At week-8, patients are asked to remove the arm sling or figure-of-eight bandage and perform full weight-bearing.

In the operative group, the subject was done with general anesthesia. Patient in supine position with a pillow in the affected shoulder. Anterior approach was performed with the protection of the supraclavicular nerve. The fracture was reduced to gain a normal length. In comminuted fracture, we reduced as anatomical possible and fixed with a 3.5mm S-reconstruction plate in a superior clavicle with a minimum of six cortices in each fragment. If necessary, a lag screw is also added to stabilized fragments. The wound was sutured with an absorbable monofilament suture. The patient was given an arm sling for 10-14 days until the wound completely healed. Active range of motion exercise started in the second week (Figure 3).

We evaluated patients retrospectively, and minimal evaluation was six months after injury. We use telephone, texting, mail, and home visiting to contact patients to complete the DASH (Disability of Arm, Shoulder, and Elbow) score questionnaire and SCC (Shoulder Constant Score) and Manual Muscle Test. DASH Score consists of 30 questions to evaluate patients' functional activity. Scores ranging from 0 (no disabilities) to 100 (most severe disability). Constant Shoulder Score consists of two parts. The first part is a patient's function, while the second part consists of the patient's shoulder Range of Movement with a possible maximum score total of 100 points (best function). Manual Muscle test consists of 5 levels with level 0 is no contraction, and 5 showed full ROM.

Complications include nonunion, malunion, infection, and implant failure. Nonunion described if no evidence of healing three months after injury. Malunion described the presence of angular deformity and shortening > 2 cm with persistent pain three months after injury.

Samples are tested using an independent T-test form ROM, MMT, SCS, and DASH score. Values < 0.005 represent a significant difference—evaluation of union using Pearson Chi-square analysis. P-value < 0.05 represents a statically significant difference. Analysis was performed using SPSS v 23.0.

RESULTS

We evaluated 161 patients with a midshaft clavicle fracture, consisting of patients operated found 77 patients (47.8%), and the conservative group was
84 patients (52.2%). The patients’ characteristics were a male total of 117 patients (72.7%), and female 44 patients (27.3%). Patients’ ages range from 18-60 years old, with a mean age of was 35.4 ± 12.23 years old (Table 1). Mode of injury divided into Motor vehicle collisions (MVC) 25 patients (14.28%), motorcycle crash (MCC) for 34 patients (21.11%), single motorcycle injury for 66 patients (41%), pedestrian vs. motorcycle 7 patients (4.36%), fall from height 17 patients (10.56%), and direct hit 12 patients (7.45%).

Significant differences showed in primary outcomes showed in DASH score, constant shoulder score, and Manual Muscle Test between two groups (p < 0.001). DASH score in the operative group was 10.85 ± 6.98, compared to the conservative group 23.67 ± 3.49, which showed better shoulder function in the operative group. Constant Shoulder Score in the operative group 93.38 ± 7.529 while in conservative group 86.60 ± 7.56. Both groups showed good results in shoulder function but with better results in the operative group (Table 2).

Even though both function between operative and conservative, shortening showed in nonoperative cases (Figure 4). Patient satisfaction
was also higher in the operative group and earlier return to activity time. Some patients complain of the lump at the anterior shoulder in the conservative group.

DISCUSSION

Clavicle midshaft fracture is one of the commonest fractures, and with good treatment will give good function because of its fast healing rate. The previous study reported 29-58 cases per 100,000 populations. In our study, we found 531 cases, around 130-150 cases per year. Based on several studies, we found the mechanism of injury mostly by a motor vehicle crash. Our study also found that single motorcycle injury is the most caused of injury by 41%. Since the motorcycle is one of the easiest modes of transportation in our country than the car, the incidence of motorcycle injury put the highest rank. Cases of males also had a higher incidence than females. According to our study, this is confirmed by male cases 72.7% and mostly in young adults.

The tendency of management therapy for midshaft clavicle fracture had moved from conservative to the operative. The nonoperative group has mostly complained about the risk of nonunion, shortening, shoulder malposition, and bony prominence. Patient satisfaction and union time are higher in the operative group. Faster union time and better function related to faster back to work time. Some complications like malunion and nonunion are also higher in the conservative group. Most complained symptoms in surgical groups are implant prominence and scar-related cosmetic.

Using the DASH score, the operative group showed better outcomes than the nonoperative group in our evaluation. According to a previous study by Patel, who evaluated the DASH score between operative and conservative, also showed better scores in the operative group. According to Tamaoki et al., a one-year evaluation of the DASH score showed no significant difference. Canadian orthopedic trauma society by 2007 showed the operative group had a better score. Mean Constant score was also higher in the operative group than in the conservative group.

This study showed that operative treatment gives superior functional outcomes to the conservative group. The operation can be performed using a plate and screw or TENS (Titanium Elastic Nail System), which gives smaller scar. Newer meta-analysis research showed a nonunion risk was higher in the nonoperative group (15%) than operative (2.2%), especially with good fixation technique. Some patients also complain of constant pain, nonunion, malunion, and lowered shoulder function.

It is better for patients who underwent surgery in the acute phase (less than 14 days), giving a higher union rate than performing>14 days. By performing operative, we gave rigid fixation and correct lengthening for better union and function while giving less pain and better function due to early rehabilitation and movement. Early mobilization gives faster recovery for shoulder movement and muscle strength. In longer evaluation, if there are no complaints around the shoulder, such as tingling sensation or implant prominence, removal of the implant was unnecessary, except in patients doing body contact sports. A shorter return to preinjury activity was also found in the operative group with a difference of 4 weeks faster. Some research has already compared superior and anteroinferior plating to increase patients satisfaction and less complication.

Some conservative group complications include shoulder dysfunction, mostly caused by shortening of the bone segment, residual bone deformity, loss of force, and persistent pain. Shortening 1.5-2 cm could give result in decreased shoulder function. However, conservative treatment remains a gold standard in simple undisplaced mid-shaft fracture. However, the gold standard for treatment in midshaft displaced...
and comminuted for young active adult patients must be considered a regiment of therapy related to better shoulder function.\textsuperscript{12,14,16}

\textbf{CONCLUSION}

Operative treatment of midshaft clavicle fracture has been accepted as the gold standard worldwide for displaced or comminuted fractured inactive young adults. It has better bone healing, less healing time, and superior shoulder function than conservative treatment. Patient satisfaction is also higher in the operative group. Indonesian population was mostly filled with active young adults, and a motorcycle was commonly used as main transportation, so the incidence of clavicle fracture was common. We need a multi-centered prospective randomized trial to make a better result, and objective measurement for radiologic can be added for future research.

\textbf{REFERENCES}

Case Report

Vacuum-Assisted Closure and Muscle Flap as An Alternative Modality for Infected Wound after ORIF of Tibial Fracture: Case Report

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ABSTRACT

Background: The blood supply of a bone can be decreased due to the use of an implant, leading to wound-bed bacterial colonization and the development of the SSI. The principle of vacuum-assisted closure (VAC) is to use a negative pressure environment in the wound to promote increased wound healing. The case shows that VAC application and muscle flap therapy provide the definitive healing of infected wounds after ORIF.

Case Report: A 45 years-old male presented with a close comminuted proximal third right tibia fracture and tense skin. The fracture was openly reduced and internally fixated with plate fixation and a skin flap on the fracture area. Still, the wound could not be closed due to difficulty covering the wound, so a counter incision was made. After four days, the patient developed necrosis in the post-operation wound and subsequently underwent debridement and muscle flap with VAC application.

Discussion: SSI can be treated by applicating of appropriate antibiotic and surgical procedures. In this case, the infection was treated using third-generation cephalosporin antibiotic, debridement, dissection, and re-elevation of gastrocnemius muscle flap covering the exposed plate area in inferior, split skin graft above the muscle flap and VAC above skin graft with 75 mmHg pressure.

Conclusion: Debridement with muscle flap and application of VAC in the deep infected wound of open reduction and internal fixation was found to be successful methods in minimizing complications and obtaining an optimal outcome. This finding was associated with accompanying morbidities or a good wound healing process.

Keywords: Vacuum-assisted closure; Muscle flap; Tibia fracture; Surgical site infection; Human and medicine

INTRODUCTION

Tibial fractures are treated with surgery and are at risk of serious infections. Previous studies have suggested that infections following internal fixation were higher in emerging countries, as operating rooms are often not fully sterile and may contain microbes that can cause infection.1 The incidence of infection was 1.6% in closed fracture and associated with the low serum albumin concentration, older age, obesity, smoking, diabetes mellitus, and ischemia secondary to vascular disease or irradiation. Surgical risk factors include prolonged procedures and inadequacies in either the surgical scrub or the antiseptic preparation of the skin.1 The goals of treatment are a pain-free function of the lower limb. Whether these can be best met with surgery or closed treatment depends on the injury's particular circumstances.2 Blood flow may be reduced because of an implant and can interfere with wound healing. These are liable for bacterial colonization on the wound bed and can cause severe infections.3

A closed fracture can be treated both by closed or open procedures. Common potential complications after open reduction and internal fixation (ORIF) are post-surgical infection, non-
union, malrotation, pain, compartment syndrome, and nerve injury. Early infection complicating ORIF of a limb fracture is often a challenge for both the surgeon and the patient. Cleaning the wound through irrigation and debridement was the first line of treatment in treating a deep infection after surgical ORIF. It decreases the bacterial load and infection to support fracture healing. The incidence for the most common organisms found were aerobic gram-positive and aerobic gram-negative bacteria, 69.2% and 15.4%, respectively. The most commonly isolated organism was Staphylococcus aureus (84.6%). The majority of the infections were treated with antibiotics only (53.8%) or with antibiotics and surgery (38.5%). Cephalosporin was the most commonly used antibiotic. The literature's typical length of prophylactic antibiotic use for tibia fractures ranges from 1–5 days.

Skin grafts can be applied in various conditions, such as traumatic wounds, defects after tumor resection, burn reconstruction, scar contracture release, etc. The clinical outcome of skin grafting depends on a variety of factors. The second most common cause of graft loss is infection. Henderson et al. reported a 15% graft failure rate due to infection. One soft-tissue restoration procedure for the knee is the gastrocnemius flap. The medial gastrocnemius flap is a popular procedure for covering a variety of abnormalities. When full-thickness defects have exposed tendon, bone, or implant, or when full-thickness surgical incisions cannot be closed under proper tension, such as when a draining sinus has been debrided, medial gastrocnemius flap coverage is preferred. A flap in the medial or anterior aspect of the knee that extends to the distal region. The medial gastrocnemius flap is particularly successful for treating soft tissue deficiency across the medial or anterior portion of the knee, at or distal to the inferior pole of the patella (e.g., over the tibial tuberosity or patellar tendon. Local rotating muscle flaps generally have positive outcomes, especially in complex skeletal and soft tissue restoration.

Negative pressure wound therapy (NPWT) may be used to assist wound coverage in accelerating granulation formation and removing the exudate in osteosynthesis-associated infection (OAI). VAC is one of the methods used to support wound healing. It is based on the principle that the wound's negative pressure improves the environment for wound healing. NPWT usage aims to decrease tissue edema, enhance local blood circulation, limit or prevent infection, improve flap rates, and potentially decrease the overall need for flaps. This case report evaluates the complex treatment and outcome of an infected wound following ORIF of a closed tibial fracture in a 45-year-old male patient treated with antibiotic therapy, VAC, and muscle flap.

**CASE REPORT**

A 45-year-old male had a motor vehicle accident, being crushed by a motorcycle from the opposite side before admission, passed out (+) ± 10-15 minutes, bleeding from the nose (+). On physical examination, he was compos mentis, light reflex (+), blood pressure 130/72 mmHg, pulse 65x/minute, respiratory rate 22x/minute. There were deformity and extreme edema on the right leg in the localized examination, with limited range of motion. Dorsal pedis arterial pulse was palpable. We diagnosed the patient with a closed fracture on the right tibia Tscherne classification Grade I/II. On radiographic examination (Figure 1), he had a complete closed fracture on 1/3 proximal

![Figure 1. Radiographic examination of the fracture (A) and after open reduction and internal fixation (B)](image-url)
right tibia with distal fragment displacement to posteromedial. There is a suspicious fracture on the proximal right fibula. On the operation, it was observed that there was a closed comminuted fracture of the tibia with butterfly fragment and tense skin. There was also high injury of the muscle of the anterior compartment.

The patient was then surgically treated with open reduction and internal fixation with T-plate 8 holes and six screws on the right lower leg. A counter incision was made on the medial side due to the difficulty of closing the wound. Four days later, the surgical wound was necrotic on the anterior aspect of the leg between the two incisions (Figure 2 A & B). The laboratory examination was obtained and showed leukocytosis with neutrophilia. He underwent debridement, medial gastrocnemius muscle flap, and split-thickness skin grafting. During surgery, there were nonviable tissue and pus on the wound. The pus and tissue culture were obtained. A broad-spectrum antibiotic, ceftriaxone 2 gr, was used as empiric treatment. The microbiology report then showed Klebsiella pneumonia infection. Based on the sensitivity test that shows the microbiology is sensitive to Levo-floxacin. Therefore, the antibiotic was changed into Levo-floxacin 500 mg/12 hours intravenously. The patient was discharged five days after surgery with non-weight bearing and moist wound dressing until the flap healed.

Within one month, the patient lacked compliance and did not control the wound according to the schedule. The patient came again with an open wound, pus in the right lower leg, granulation, bone, or plate seen in the wound area in the next month. The flap was viable but atrophied with pus discharge. There was no osteomyelitis or septic implant loosening (Figure 3A & B). Levo-floxacin 500 mg/12 jam was given intravenously along with an analgesic.

After two weeks, the condition was not getting better, so the patient underwent surgical debridement. The wound was found with approximately 5 x 5 cm with bone as the base of the wound. Dissection and re-elevation of medial gastrocnemius muscle flap were done to cover the exposed plate area in the inferior. A split skin graft (donor from the right femur in anterior) was applied above the muscle flap. There was no intervention to the bone plate fixation because it was stable and loosening. There was

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**Figure 2.** Clinical view. (A) After open reduction and internal fixation. The wound was found at the surgical incision at the proximal medial of the leg, and the size was found approximately 5x5 cm with muscle as the base of the wound. (B) 4 days after open reduction and internal fixation, there was a necrosis of the surgical wound.

**Figure 3.** (A&B) Open wound with bone and plate were exposed. (C) Clinical picture after the second debridement, gastrocnemius flap, and skin grafting.
only one loose screw, and it had been removed. Vacuum-assisted closure (VAC) above skin graft with 75 mmHg pressure was intermittently applied in the hospital for two weeks. The pressure was set to 75 mmHg to keep skin graft viability. The patient was given Levofloxacin for 14 days until the clinical and laboratory results were improved. After no sign of infection clinically and a decrease in the leukocyte count, the VAC was removed, and the patient was discharged two weeks post-operation. There was a granulation without pus and no bone or plate exposed on the wound. In the healing process, there is a slough appearance of the superior part of the flap (Figure 3C). The patient was given cefixime 200 mg twice daily for seven days at home.

One month after the operation, the inferior part of the wound was healed first, and two weeks later, the patient came again with granulation on the superior part of the wound (Figure 4A & B). Four months after the last operation, the wound had fully healed, and the patient could fully weight-bear. We found that the wound’s infection was handled well during this case and did not interfere with the fracture’s plate fixation and bone healing (Figure 4C).

**DISCUSSION**

This case presented a patient with gene Xpert biopsy an infected wound after the ORIF of closed tibial fracture. Fractures of the tibial shaft are the most common long bone fracture. The most common bacteria was S. aureus, followed by Pseudomonas, S. epidermidis, Enterobacteriaceae, or Enterococcus species. The bacterial spectrum corresponded with the incidence in the literature. Operative time and open fractures are independent predictors of postoperative infections. Cefalosporin was the most commonly used antibiotic; in this case, we used third-generation cephalosporin, ceftriaxone, as antibiotic therapy for this patient. The bone stabilizing method was widely variable across studies. Some authors reported temporary external fixation, followed by a plate or an intramedullary device. As in this case, internal fixation was done with T-plate 8 holes and six screws on the right tibia. A similar case was reported by Karbalaeikhani et al., with a tibial fracture case. The hardware plate performed open reduction and internal fixation of the tibia fracture. A few days after the operation, soft tissue necrosis was seen at the incision site, and the implanted hardware was exposed. We decided to cover the exposed hardware by the medial head of the gastrocnemius muscle flap. After five days, the tie-over of the grafted muscle flap was removed. Complete healing of the exposed area and exposed hardware occurred without any complication. In this case, the fracture was stabilized with open reduction and internal fixation with T-plate 8 holes and six screws on the right crusis. Due to difficulty covering the wound, a counter incision was made on the medial side.

Local circulation can be compromised by using an internal implant, which can further contribute to producing an area liable to infection. The second most common cause of graft loss is an infection, with hematoma formation being the most

![Figure 4. Wound healing at (A) One month. (B) One month, and two weeks. (C) Four months after the operation.](image-url)
common. The wound may have poor local circulation, or the surface contamination may have been too significant to allow graft survival. Technical errors such as applying the graft dermis side in the superficial will result in complete graft loss. Using excess pressure, stretching the graft too tightly, or handling the graft in other traumatic ways may lead to partial or complete graft failure. These might be the problem that caused the necrosis of the post-operation wound in this case. Four days later, the patient underwent debridement with prophylaxis antibiotic, gastrocnemius muscle flap, and split skin grafting due to the necrotic wound. Gastrocnemius muscular flaps, particularly the medial head, showed an excellent result. It has some benefits: it is a reliable flap, even in the older patients; its vascular anatomy is consistent; the excellent caliber of the pedicle; and its dissection is rather easier to be done.

Due to lack of compliance a month later, the patient came again with an open wound, pus in the right cruris, granulation, bone, or plate seen in the wound area. He was treated with cephalosporin antibiotic injection, debridement, dissection, and re-elevation of gastrocnemius muscle flap covering the exposed plate area in the inferior. He split skin graft (donor from the right femur in anterior) applied above the muscle flap. Vacuum-assisted closure (VAC) above skin graft with 75 mmHg pressure for two weeks in the hospital. NPWT had been reported to be a suitable method in managing wound infection after hip replacement surgery. Another study had also reported the use of VAC to treat deep wound infection after spinal instrumentation surgery. An excellent outcome had been reported, but it was only from an observation from two patients. Another study, which was observed with more detail at infection after hip arthroplasty, found infection resolution in 26 from 28 patients, with the mean duration of treatment of 9 days (3 – 16 days) with the mean follow-up of 3 years. A study by Lehner et al. showed that NPWT produced showed a cure rate of more than 80% with retention of the implants in infections, both acute and chronic.

Some prefer negative pressure wound therapy to treat infected wounds because negative pressure wound therapy has been reported to increase granulation tissue formation, enhance local blood flow, and decrease the bacterial burden and infection rates, among other metrics. VAC had been proven to remove interstitial fluid from wounds, increase wound vascularization, and decrease the bacterial load. It could also benefit other diseases such as chronic open wounds, common problems with spinal cord injury, postoperative spinal surgical infections, and diabetic ulcer cases. It is a safe and reliable method to manage. It is safe to manage infected wounds, open fracture wounds, related soft tissue complications, and acute soft tissue lacerations. As a result, the outcomes in all studies and cases were satisfactory. In addition, VAC devices were also indicated for severe traumatic and dehisced wounds. VAC usage in the infection after trauma was also referred to because of its significantly effective antimicrobial feature.

CONCLUSION

Vacuum-assisted closure (VAC) in infected wounds after open reduction and internal fixation seems suitable for reducing complications and achieving the best result. In this case, staged treatment from open reduction and internal fixation with plate and screws, followed by gastrocnemius muscle flap and split skin grafting. At last, the infection was treated with vacuum-assisted closure. Our treatment results were satisfactory in the last stage. These results may be based on accompanying morbidities or good wound healing. We found that infection of the wound was handled well during this case and did not interfere with the fracture's plate fixation and bone healing. However, we think that treatment protocol, including vacuum-assisted closure, is a reliable method, especially to avoid complications resulting from an infected wound of open reduction or any chronic open wound.
REFERENCES


Case Report

Agenesis of Medial Patellofemoral Ligament (MPFL) with Habitual Patellar Dislocation in Adolescent Woman with Cerebral Palsy – Case Report

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ABSTRACT

Background: The current treatment for habitual dislocation and nonoperative treatment failure is surgical therapy. Therefore, this study describes chronic patella dislocation's comprehensive evaluation and management in an adolescent woman with cerebral palsy (CP).

Case Report: A 15 years old female patient has suffered knee pain for almost three years. Furthermore, the physical examination revealed positive adam's forward bending test and left knee cap dislocation with positive patellar J-sign at 90°. Radiologic examination of the vertebrae and left knee shows scoliosis left thoracolumbar curved with 43 Cobb angle and patellar shift. The patient was then diagnosed with habitual patellar dislocation, spastic diplegia type of CP, and neuromuscular scoliosis, consulted to the pediatric department, and then planned for medial patellofemoral ligament (MPFL) reconstruction. During the surgical examination, we discovered the MPFL Agenesis. Finally, lateral release and plication of the medial retinaculum were selected for surgery and planned to receive a Boston brace for scoliosis. After six weeks of follow up, the patient shows a reduction in pain.

Discussion: Lateral release and MPFL reconstruction for patellar stabilization generate better results. However, in this case, the absence of the medial patellar facet and the medial femoral condyle enhances Lateral release and plication of the medial retinaculum more preferable to fixate the left patella and improve functional limitation.

Conclusion: Comprehensive and immediate treatment for a patient with habitual patella dislocation and other predisposition diseases increases the chances of success.

Keywords: Agenesis MPFL; Cerebral palsy; Human and medicine; Habitual patella dislocation; Surgical treatment

INTRODUCTION

Children with disability may occur suffer in their lives. It is known to be one of the cause neonatal death in the world. The prevalence of congenital abnormalities in Indonesia is about 59.3 for every 1000 live birth.1 Furthermore, the congenital abnormalities that arise physical problems include the instability of patella, which is identified by dislocation or subluxation of the patella in the lateral direction.2–4 Hasler and Studer reported that patients with habitual patella dislocation from combined predisposition factors such as trochlear dysplasia, malalignment, ligamentous laxity, and hypoplastic condyle should be considered for surgical procedures treatment.4

The decision-making in surgical procedures is based on orthopedic examination during the presurgical and surgical process.4 Furthermore, the patients with habitual and recurrent patella dislocation, specifically without trauma, have a poorer stabilization prognosis and develop re-dislocation post-treatment.5 Therefore, patients with these injuries require immediately advanced imaging and surgical repair because early identification and diagnosis with the conformity of surgical medication in-
crease the chances of success. Hence, this study describes the holistic examination and management of habitual patella dislocation in adolescent patients with congenital disease.

CASE REPORT

In February 2020, a 15 years old female patient with knee and back pain was present in the orthopedic department of Dr. Soeroto Ngawi Regional Public Hospital. The patient suffered for almost three years and felt sick from walking long distances during sport. The patient also complained about breathing, back deformity, right-hand finger stiffness without complaint of hands function, diplegic gait abnormalities, knee instability, and cognitive impairment. The patient’s knee pain and instability often felt better at rest and worse while performing a heavy activity. Also, the patient had not visited the doctor nor taken certain medicine before.

The patient has a record of congenital abnormalities at birth. Additionally, the mother has an advanced maternal age of 40 years old. There is no history of teratogenic exposure and infection during pregnancy, and the mother routinely experiences prenatal checkups. The baby was given a midwife vaginal delivery in the 36 weeks of gestation with a birth weight of 3500 grams and a body length of 50 cm.

Nursing difficulties arose from the start, whereby the baby could not cry spontaneously, having yellow skin color and low muscular tone activity. A few days after birth, the patient had respiratory distress and difficulty swallowing. Also, the patient had a history of complete immunization, six months of breastfeeding, and complimentary food after that.

As the patient grew older, there was still difficulty standing and walking until the age of 2, had monosyllable speech, and could not speak eloquently until the age of 4. Moreover, the patient experienced several difficulties memorizing, counting, and reading during the school period. Meanwhile, there is no history of similar abnormalities among the families, including the grandmother’s family.

At the time of presentation, physical examination revealed strabismus in the eye exam, right chest protrusion, asymmetrical shoulder (right shoulder is taller than the left shoulder), and the gap between arm and body trunk (Figure 1) in chest exam, spine deformity, forming “S” Shape with bending to the right, rib hump at the right side of the thorax region, and lower back hump at the left hip are discovered on back examination (Figure 1). Gait assessment revealed diplegic gait abnormality in the upper extremities and difficulties climbing up and down the stairs. At the same time, there is no symptom in other gaits such as neuropathic, myopathic, choreiform, etc. Adam’s Forward bending test showed asymmetrical back without change before and after the test (Figure 2).

![Figure 1. The back’s Inspection shows deformity. Arrow; Red: asymmetric of head and body axis; Green: shoulder asymmetric; black: right rib hump and left hip lower hump positive; Blue: the curve of spine; Orange: the gap between arm and trunk.](image)

![Figure 2. Adam’s Forward Bending Test. It looks asymmetrical, and there is no change in the back shape before and during the test. Arrow; Red: Right rib hump positive.](image)
2). Upper extremities examination revealed hypertonic muscle on both sides, spastic specifically on the right hand, and positive pathological reflex on both hands. The Marshall test shows hyperextension on both hands and above 10 degrees elbow angle.

Inferior extremities examination revealed hypertonic muscle on both sides, limited Range of Movement (ROM), and limitation in patella mobility which patella shifting of the left knee cap with patellar J-sign positive in 90° extensions and 45° flexions. The Beighton scale measurement was 8 (Table 1), and the Apprehension test was positive.

The plain thoracolumbar radiologic imaging revealed left curve spine thoracolumbar scoliosis with 43 degrees cobb angle (Figure 3). In contrast, left knee radiologic imaging revealed patella shifting with 19 degrees of the Q angle (Figure 4) and no high patella in 30 degrees of flexion in the left knee for Blumensaat’s line (Figure 5). Skyline merchant Knee X-Ray views were not evaluated during presurgical examination.

The final examination, either presurgical or during the surgical approach, confirmed that diagnosis for this patient is agenesis of MPFL with habitual patellar dislocation, spastic diplegia type cerebral palsy, and neuromuscular structural scoliosis.

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<th>Measurement</th>
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<td>Passive dorsiflexion and hyper-extension of the fifth MCP joint beyond 90°</td>
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<td>Passive hyperextension of the elbow beyond 10°</td>
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<td>Passive hyperextension of the knee beyond 10°</td>
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<td>Active forward flexion of the trunk with the knees fully extended so that the palms of the hands rest flat on the floor</td>
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**Total Score** 8

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**Figure 3.** Plain thoracolumbar radiologic

**Figure 4.** A 19 degree of the Q angle

**Figure 5.** There is no high patella in 30 degrees of flexion in the left knee for Blumensaat’s line
Surgical Approach

After experiencing all series of examinations, the patient experienced MPFL reconstruction, preceded by patella examination preoperative. Then, advanced examination under anesthesia is performed to evaluate ligament stability and the patella mobility in extension and flexion patella. The patellar surgical contains medial patellar approach and identification of medial retinaculum and remnant of the MPFL. The MPFL identification showed the absence of medial facet patellar and medial femoral condyle. These findings were referred to as the agenesis of MPFL. Therefore, medial plication from the caps and the retinaculum and lateral retinacular release at the left knee was more preferred than the MPFL reconstruction due to its absence.

A week after the operation, the patient had not complained of pain or other abnormal symptoms. The patient received several therapies, including physical therapy for muscle strengthening gait training, and suggested using Boston’s brace for scoliosis.

Post-Operative Evaluation

After receiving the complex therapy, including operative, medication, and physical therapy, the left patella's stability was evaluated. Clinical appearance after six months post-operation, the surgical wound was healed, felt the least pain when moving the left knee, able to stand and walk without walking aids, and no complaint while sitting with a flexed knee. In addition, the physical examination shows re-dislocation and subluxation of the left patella revealed to J-sign positive in 20° flexions of the left knee, which shows a better result from the first examination. Also, the Merchant view of X-Ray examination through radiological assessment was evaluated. This assessment identified the malposition of the articular surface patella outside of the patellofemoral surface, which is located in the lateral side of the femoral condyle. The absence of medial facet patellar and medial femoral condyle could develop the displacement of the patella while such maneuvers that are flexion or extension were applied. The medial plication was assumed from the caps and the retinaculum, which were not strong enough to fixate the patella. However, the operation succeeded in reducing the pain and increasing the patient’s mobility, one of which is no complaint in climbing up and down the stairs.

DISCUSSION

Patients with cerebral palsy (CP), Agenesis of MPFL, and scoliosis are rare cases. Meanwhile, this is the only case reported in the literature. The objective of this study was to determine the holistic examination and management of habitual patella dislocation in adolescent patients with congenital disease.

Based on the anamnesis and examination, this patient complains of knee pain due to patellar dislocation, although it has been given nonoperative management. However, nearly all patellar dislocation is treated by the conservative procedure. Besides, the surgery will be needed if adequate bracing and muscle strengthening do not reduce pain.

For more than decades, a different surgical technique has been described for patellar dislocation treatment. The various procedures that have been described are anatomical and non-anatomical reconstruction. MPFL reconstruction improves the anatomical repair of recurrent and habitual patellar dislocation. MPFL plays a role in the patella as a soft tissue stabilizer and prevents patellar dislocations. The successful patellar stabilization with MPFL reconstruction depends on several factors. The first is appropriate patient selection, and the second is a proper surgical technique. In this case, the main problem was the absence of MPFL, and no MPFL remnants were discovered. Therefore, the surgery was performed by medial plication and lateral retinacular release,
which many authors previously described, which is not a new technique.\textsuperscript{6–8}

In this case, the holistic examination was conducted and diagnosed with spastic diplegia type of cerebral palsy with idiopathic structural scoliosis, habitual left knee dislocation, and the absence of MPFL on the left knee. By discovering these abnormalities, treatment in pharmacotherapy, physical therapy, and decision in operation procedures could be decided and benefit the patient. On the other hand, patellar stabilization in habitual patellar dislocation will not be successful if multi-pathologies are present. Hence, a holistic examination should be performed to determine the abnormality and other pathologies.\textsuperscript{6}

There is a correlation in each of the patient abnormalities that have been described in many studies. The children who had CP were born with an immature brain which consequential musculoskeletal deformities.\textsuperscript{9} About 50\%–75\% of patients with quadriplegic CP have severe motor involvement that leads to spinal deformities such as scoliosis and impairment in the development of movement muscle tone and posture.\textsuperscript{9} The etiology of scoliosis in CP has yet to be well defined. Spinal deformity is associated with muscular imbalance around the spinal axis from either spastic or flaccid muscular weakness. In studies focusing on CP, the factors contributing to the development of spinal deformity have been suggested to include spasticity, muscle weakness, and poor muscle control.\textsuperscript{10} Previous studies of 70 children (aged 12-18 years) with severe spastic and/or dystonic cerebral palsy showed that the present history of previous hip surgery, intractable epilepsy, and female gender are significant predictors of developing severe scoliosis in children with CP.\textsuperscript{11} Hagglund et al., who used the Gross Motor Function Classification System (GMFCS) was discovered scoliosis signs start to appear from the age of 5 years old. By the time they would have a risk of $\geq0^\circ$ Cobb angle (75\%), which means the motoric cannot be function normally (GMFCS I) (0\%).\textsuperscript{12} The mechanism of spine deformity in CP patients began from the early phase of postnatal child development. The development of scoliosis in CP patients is thought to result partly from persistent primitive reflex patterns and asymmetrical tone in the paraspinous and intercostal muscles. Placing patients with a weak trunk and total body involvement into artificial upright positions without appropriate spinal support may encourage gravity-related kyphosis and scoliosis. Lack of neuromuscular control prevents proper head alignment, which means these patients do not develop compensatory curves to bring the shoulders and head over the pelvis.\textsuperscript{13} This distortion is also affected by anatomical factors such as muscle tone, laxity of ligamentous structures, joint position and mobility, gravitation, motor damage, and postural factor.\textsuperscript{12,11} Physical treatment for scoliosis, including bracing, is currently not fully known whether there is a difference in effectiveness between brace types. According to a study by Costa, Schlosser, Jimale, et al., rigid braces have a high success rate compared to soft brace for Adolescent Idiopathic Scoliosis (AIS) 73.2\% (95\% CI 61-86\%). Brace types included in rigid braces are Boston, Cheneau brace, Progressive Action Short Brace (PASB), etc.\textsuperscript{14} Therefore, it was suggested that the patient take the Boston’s brace for her scoliosis.

Furthermore, recurrent dislocation of the left knee among the patient is caused by two factors, namely an anatomical abnormality and ligament laxity. Since patellofemoral stability depends on multifactorial tissue stabilizers, osseous structures, and lower limb alignment, the MPFL is a major tissue stabilizer for knee mobility.\textsuperscript{6} Unfortunately, an advanced examination under anesthesia revealed the agenesis of MPFL. Hence, decision-making for surgery was medial plication of the caps and the retinaculum and the release of lateral retinacular. This technique is previously described by Fonseca for patellofemoral joint surgery.\textsuperscript{8} The basic theory for this technique is the imbalance of the knee caused by excessive tension of the lateral retinaculum, which leads to patella instability and knee pain. Releasing the
lateral retinaculum reduces pressure on the lateral surface during flexion.\textsuperscript{8,15} Meanwhile, the absence of medial facet patellar and medial femoral condyle is no contraindication for MPFL reconstruction. Instead, it indicates the medial retinaculum plication as a major technique in such conditions. The medial retinaculum plication (MRP) is less invasive, has a cosmetic advantage, and does not reconstruct the medial patellofemoral ligament.\textsuperscript{16} Therefore, this case study revealed the agenesis of MPFL and stated that MRP is the best choice for the surgical technique.

**CONCLUSION**

A deep anamnesis and holistic examination assist in determining the diagnosis and deciding the appropriate treatment. For example, recent challenges in examining a patient with knee pain and cerebral palsy are not limited to the subjective and neurological condition of the patient. However, the patient needs to include functional, morphological, and anatomical changes to determine the objective side. Therefore, these aim to discover the abnormality which becomes a confounding factor in patient treatment.

**REFERENCES**

Case Report
Re-fracture as Impact of Rigid Implant and Bone Osteoporosis: A Case Report

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ABSTRACT

Background: The increasing life expectancy of the world population associated with osteopenia and osteoporosis leads to low-energy fractures, especially in the lower limb. The overtaking of locking plates has widened the area of close fracture fixation, and it is essential to justify and optimize their usage. This study aims to report the potential postoperative re-fracture after implant removal and as a consequence of bone osteoporosis.

Case report: We present a re-fracture of proximal femur case in 60 years old female after a trivial fall into her right femur. This patient underwent a removal implant surgery a week before in the same spot where she fell. The open surgery was made with the same incision, and we do the Open Reduction Internal Fixation for her.

Discussion: The major design of the fixation tool is to secure the fracture with less effect on native axial load stress from the whole bone. Stress shielding caused due to firm bone-implant results in its resorption. The bone degradation underneath gives rise to the plate's collapse, resulting in repeated bone breakage. Early discharge, continued weight-bearing training for proximal femur fractures were associated with speedy improvement in daily activities. The photodynamic polymer liquid was the latest technology for bone stabilization.

Conclusion: Rigid bone plates can cause stress shielding, and when the implants are removed, re-fracture easily happens. Therefore, discharge of patients quickly for weight-bearing training in proximal femur fractures was encouraged to promote better healing.

Keywords: Fracture; Osteoporosis; Bone plates; Life expectancy; Human and medicine

INTRODUCTION

In this recent decade, the life expectancy of humans has increased globally. It is concurrent with the active lifestyle of the elderly today and the reduction of musculoskeletal capability, resulting in osteopenia and osteoporosis.¹ Osteoporosis is a degenerative disease in which the bone is susceptible to fracture due to decreased bone mineral density (BMD). Eight million women and 2 million men in the United States are affected by this disease. Also, 34 million of them have low bone mass. Trivial fractures, like hip fractures, repeatedly happen because of them.² The disability and functional disturbances, even death, are mainly because of this fracture. Fractures of the proximal femur are common in the elderly, especially on the intracapsular (of the femoral neck) and extracapsular (trans-trochanteric and subtrochanteric) types.¹ Data reported that osteoporotic fracture complications had made significant health and economic burdens.²

Proximal femoral fracture is one of the most common fractures because of which elderly patients get admitted to an orthopedic trauma ward. They account for 90% of all fractures occurring in the proximal femoral region.³ Nearly half of these are divided into intertrochanteric or subtrochanteric fractures. If the patterns are unstable, its management needs serious effort to reduce and retain them. Usually, it happens together with complicating factors like poor bone quality and the inability to limit weight-bearing.⁴ In general, the locking plates’ debut has enlarged the area of fixing close fracture and plate fixation more specifically. Because of pitfalls and limits, its usage
needs to be justified and optimized. When the poor bone quality undergoes removal implant procedure, orthopedic should concern with the postoperative management. Because re-fracture could happen due to several factors following implant removal, such as bed rest duration after implant removal procedure, age, gender, and bone mineral density. In this study, we report a case of an older woman with re-fracture after implant removal in her right proximal femur.

**CASE REPORT**

A 60-year-old female was admitted to ER with the chief complaint of excruciating pain on the right upper limb and the ipsilateral wrist joint after a trivial fall when she was walking in front of her house, and her right-hand acts as body support. She cannot move her hip joint and wrist joint. She mentioned that 10-days before, she was undergoing a removal implant surgery at the same spot where she fell again. In May 2019, she had the first right proximal femur fracture and right proximal humerus fracture surgery. Both of these fractures were treated using the proximal locking compression plate.

The primary survey is stable with no remarkable injury. After a brief physical examination, a stitched scar with a small bruise on the patient's right femur area, with mild LLD found without any rotation on her hip. She can barely not flex her hip passively. There is minimal swelling on the right wrist joint without any open wound, bruise, or visible deformities. Her wrist joint movement is very limited because of pain. The plain X-Ray of the thorax, hip, and wrist joint is done to evaluate her right femur and wrist joint condition.

It shows a closed fracture of the proximal third right femur and a closed fracture of the distal right radius (Figures 1A and 1B). The thorax X-Ray also confirms the previous right proximal humerus implant surgery. She also brings the previous X-Ray of the right femur when she had the first surgery and after undergoing the removal implant surgery (Figures 1C and 1D). From the last X-Ray, before she undergoes the removal implant surgery, it seems that her right femur bone has signs of osteoporotic bone even after two years after the first surgery (Figure 1D). Using the same incision with the previous surgery, we do the Open Reduction Internal Fixation for her (Figure 1E). Two weeks after this procedure, in the OPD, there were no significant complaints and complications in this patient. She went to scheduled rehabilitation faster after the surgery.

**Figure 1.** (A) Plain X-Ray of Hip after the patient fell, (B) Plain X-Ray of Wrist Joint, (C) Plain X-Ray of Femur after two years of the first surgery, (D) Plain X-Ray of Femur after Removal Surgery, (E) Postoperative X-Ray
DISCUSSION

Bone is a miraculous tissue; it always repairs itself through a process back to normal function whenever there is damage. The skeletal system can tamper with some diseases, disorders, and trauma. A Discontinuity of the bone cortex, with a degree of injury to the surrounding soft tissues commonly referred to as fractures. This skeletal system issue can elevate the mortality rate, which has a different value in every bone. An implant is needed for this issue, or it can also cause a fracture. In severe cases, implants become mandatory—because they need realignment and fixation for proper healing—or somehow, it completely fails to regenerate, producing bone defects.

After fractures happen, the bone will heal in two ways, direct (primary) or indirect (secondary) healing. Primary healing is the bone cortex restoration without callus formation. It resulted from rigid fixation because of a fragment of bony vascular surfaces in contact. Secondary healing is natural bone restoration through three phases. First is an inflammatory phase that starts directly after fractures. After the rupture of bone and periosteum, the hematoma was formed and brought all pro-inflammatory substances such as vascular endothelial growth factor (VEGF) to encourage the healing process. The second phase, the reparative phase, happens when primordial bone cells begin to take action to make a soft callus and continuously replace it with a hard callus. The last phase is the remodeling phase, where the bone begins to back to normal anatomical and physiological function.

The fracture holds steady by the bone plate/bone implant (i.e., to make sure the fracture site is always under slight compression) while minimally affecting the natural stress state of the bone. Bone healing process with an implant is similar to non-implant bone healing. As implant stabilization, the bone formation around it extremely relies on the surface chemistry and implant topography. Locking plates make bone healing vary depending on the fracture site. Intrarticular fragment needs to return to an anatomical position with contact with each other fragment if in the epiphyseal area. While in the diaphyseal area, it is not required to directly reduce the intermediate fragment when alignment (coronal, sagittal, and rotational) and bone length are restored.

The inflammatory process started as soon as the implant was used, and hematoma formed underneath. This inflammatory process culminates in the recruitment of mesenchymal stem cells (MSCs) to the implant's surface. The cells became osteoblast, which later became the new bone along the edge. It is called contact osteogenesis. Because of contact osteogenesis, bone bonding is formed only if the implant surface has good topography. In distance osteogenesis, it grows from the old bone surface to the implant surface in an oppositional way. Both of them encourage the forming of immature woven bone, fill the gaps between the bone and implant. The remodeling phase of this sub-implant space begins from immature bone to the mature bone.

While bone stabilization happens, bone union through the remodeling phase occurs if overly stiff conditions. It will not be healed. If not stiff enough, it would be compromised. The natural stress state of bone changes accidentally because of the plate compared to the state before fracture. Some bone parts are shielded from either tensile or compressive stress or both. It is well known that the bone reacts to applied stress through remodeling. Stress shielding caused due to rigid bone-plates results in bone resorption. Implant failure and re-fracture after removal surgery could happen because of this sub-implant bone resorption. To prevent the re-fracture, good rehabilitation programs should be initiated early after ambulation. It can be started with partial weight-bearing until carefully used in daily activities.

Reducing death rate, the short length of
stay, and discharge of the patient was linked to immediate ambulation with weight-bearing training after proximal fracture surgery. It also helps to boost the psychological confidence and morale of the patient. Most hip fracture patients should be allowed unrestricted weight-bearing and mobilization post-surgery. Restricted weight bearing or delayed mobilization may delay functional recovery, delay the return to independent living, and result in depression and anxiety. Allowing patients early mobilization after stabilizing these fractures also helps prevent bedsores, deep vein thrombosis, pulmonary complications, and muscle atrophy. As a mechanical force given to the bone, it responds with its ability to rebuild and change architecture. The bone strain is in homeostatic conditions with balanced turnover for osteoblast and osteoclast in normal physiological conditions. Animal study shows that if a moderate axial loading is given to the osteotomy site, the callus forms thicker and union quicker than enormous early loading or even no loading. In vitro osteoblast activity (proliferation and synthesis) begins while there are moderate uniaxial strains between 0.3 and 2.8%. At first, granulation tissue and fibrous callus will form in the fracture site due to the high strain, when it becomes stiffer until the strain is low enough as the bone formation.

Axial loading and weight-bearing will act as outside stimuli, improving bone ability to heal at the fracture site. The same healing process in osteoporotic bone happened for quite longer. Direct load-bearing supported with favorable blood supply at the fracture site, fortified by micro-movement and fracture steadiness, will improve bone healing. In situ mechanical elements influence cell differentiation and phenotype: osteoblastic differentiation is supported by small to moderate strain, while larger strains promote the fibroblastic cells and increase fibrous union possibility. After surgery, the weight-bearing training only focused on early mobilization and restoration of physiological function to encourage healing while evading displacement of fracture or implant failure. The biomechanical study from 2 groups of cadaveric bone shows that the PFN surpasses the PFLCP in axial rigidity, subsidence, and the number of specimens that failed to fix oblique proximal femur. Nandakumar R et al. studied 60 patients with an intertrochanteric fracture treated surgically with Proximal Femoral Nail (PFN). This study concluded that early mobilization with full weight-bearing gives a good outcome and reduces morbidity and mortality. It also boosts the patient's confidence, which has a good effect on the well-being and morale and should be recommended following intertrochanteric fracture fixation with Proximal Femoral Nail (PFN).

Other studies about early weight-bearing after proximal femur or hip fracture also showed similar results. It is stated that femoral shaft fracture treated with PFN allowed for immediate mobilization with WBAT. There are many recommendations for preventing re-fracture caused by implant-induced osteoporotic make a significant challenge for surgeons. The latest technology was the minimally invasive Photodynamic Bone Stabilization System, said to be a novel technique for surgical repair of osteoporotic fractures in long bones that provides enhanced stability and excellent clinical results.

CONCLUSION

In this study, we present a case of a female elderly who got re-fractured after she fell. Ten days earlier, she had her implant removed from her proximal femur. This case reminds us that small things could happen anytime, even if we are already prepared to prevent them, because stiff bone plates can cause stress shielding, which results in bone resorption and can result in re-fracture of the bone when the fixation device is removed.

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