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ANALYSIS OF OPEN REDUCTION AND INTERNAL FIXATION (ORIF) IN COLLES' FRACTURE

Iasmim Camila Chaves Pessoa, Sylvia Ferreira Grisi Paiva, Eduardo Eugênio Miranda Alencar, João Vitor Cunha Lima Paranhos, Maria Eduarda de Melo Silva Pessoa, Bruno de Vasconcelos Braga, Paulo André Jordão de Paiva Serpa, Ariana Nicol Eugenio Vela, Matheus Cortizo Carballal, Karla Emanuelly Cassemiro da Silva, Leonardo Barroso de Moraes Santos, Márcio Moreira Saraiva Ribeiro, Victória Rocha Pereira da Silva, Fernando Antônio Ferreira de Andrade Júnior, Mariana Moura de Luna Souza, Maria Eduarda Pontes Beltrão, Maria Fernanda Dias Correa de Araújo, Amanda Diely Brito Bulhões da Silva

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REVISÃO SISTEMÁTICA

ABSTRACT

Colles fracture, first described in 1814, is characterized by the dorsal displacement of the distal radius fragment and is highly prevalent, particularly among elderly patients. This study aims to evaluate the effectiveness of Open Reduction and Internal Fixation (ORIF) in treating Colles fractures, focusing on functional outcomes and postoperative quality of life. An integrative literature review and comparative analysis of studies on ORIF and other treatment methods were conducted using Google Scholar, Scopus, and Web of Science as indexing tools. Articles were selected using the keywords “Colles Fracture, Open Reduction and Internal Fixation, Functional Outcomes, Postoperative Complications.” The review highlights that ORIF generally provides superior functional outcomes and fewer complications in various fractures, such as those of the humerus, tibial pilon, calcaneus, and unstable distal radius fractures, compared to less invasive methods like external fixation (EF). However, EF shows advantages in specific cases, such as shorter surgical time and fewer perioperative complications. Moreover, the studies indicate that risk factors like diabetes, fracture severity, lack of drainage, and bone graft usage increase the risk of complications in ORIF. Additionally, minimally invasive techniques can reduce pain and enhance functional recovery in certain fractures, such as patellar fractures, when compared to ORIF.

Keywords: Colles Fracture, Open Reduction and Internal Fixation, Functional Outcomes, Postoperative Complications.

ANÁLISE DA REDUÇÃO ABERTA E FIXAÇÃO INTERNA (ORIF) NA FRATURA DE COLLES

RESUMO

A fratura de Colles, descrita pela primeira vez em 1814, é caracterizada pelo deslocamento dorsal do fragmento distal do rádio e é altamente prevalente, principalmente entre pacientes idosos. Este estudo tem como objetivo avaliar a eficácia da Redução Aberta e Fixação Interna (RAFI) no tratamento das fraturas de Colles, com foco nos desfechos funcionais e na qualidade de vida pós-operatória. Foi realizada uma revisão integrativa da literatura e uma análise comparativa de estudos sobre RAFI e outros métodos de tratamento, utilizando Google Scholar, Scopus e Web of Science como ferramentas de indexação. Os artigos foram selecionados com os descritores “Fratura de Colles, Redução Aberta e Fixação Interna, Resultados Funcionais, Complicações Pós-operatórias”. A revisão destaca que a RAFI geralmente oferece melhores resultados funcionais e menos complicações em várias fraturas, como as do úmero, pilão tibial, calcâneo e fraturas instáveis do rádio distal, em comparação com métodos menos invasivos, como a fixação externa (FE). No entanto, a FE apresenta vantagens em casos específicos, como menor tempo cirúrgico e menos complicações perioperatórias. Além disso, os estudos indicam que fatores de risco como diabetes, gravidade da fratura, falta de drenagem e o uso de enxertos ósseos aumentam o risco de complicações na RAFI. Técnicas minimamente invasivas também podem reduzir a dor e melhorar a recuperação funcional em certas fraturas, como as fraturas patelares, quando comparadas à RAFI.

Palavras-chave: Fratura de Colles, Redução Aberta e Fixação Interna, Resultados Funcionais, Complicações Pós-operatórias.

Instituição afiliada – UNINASSAU, AFYA-JABOATÃO, FMO, FPS, UPE
Autor correspondente*: Iasmim Camila Chaves Pessoa* mateusafmelo@gmail.com

INTRODUÇÃO

The Colles fracture, characterized by the dorsal displacement of the distal radius fragment, was first described in 1814 by the surgeon Abraham Colles. It is one of the most common forearm injuries, particularly in elderly patients following falls onto an outstretched hand. It is estimated that this fracture accounts for approximately 15% of all fractures treated in emergency services, making it a significant public health issue due to its high incidence and functional impact (Gouk, 2019). In this context, the Open Reduction and Internal Fixation (ORIF) technique is a surgical option used for fractures of the distal radius that require greater precision and stability of the bone fragments. Proper management of this fracture is essential to restore upper limb function and prevent long-term complications such as joint stiffness and chronic pain, which can affect up to 30% of patients when the initial treatment is inadequate (Lo et al, 2021).

Historically, the treatment of Colles fracture relied on closed reduction followed by immobilization with a cast, an approach still prevalent for stable cases. However, the failure rate of this method in unstable fractures can reach up to 60%, resulting in residual deformities and significant functional loss (Cui, 2018). As an alternative, Open Reduction and Internal Fixation (ORIF) has been widely adopted, demonstrating superiority in anatomical alignment and functional recovery (Yuan et al, 2018) Nevertheless, despite its benefits, there are gaps in the literature that need to be addressed, particularly regarding the comparison of ORIF's efficacy with less invasive methods, such as external fixation, and the analysis of long-term complications, whose rates range between 15% and 25% (Sharma et al, 2018; Tripathy et al, 2021).

ORIF, which involves the direct exposure of the fracture and fixation with plates and screws, is associated with better clinical outcomes, with rates of reduction loss below 10% and complete functional recovery in up to 85% of patients (Wu et al, 2016; Zhao et al, 2017). However, this technique is not without complications, such as infections, which can occur in up to 12% of cases, and nerve injuries, raising questions about its cost-effectiveness compared to other techniques (Wang et al, 2014; Zhang et al, 2015). These controversies highlight the need for additional studies to

comprehensively evaluate the functional outcomes and quality of life of patients treated with ORIF.

Given this scenario, the present study aims to evaluate the efficacy of Open Reduction and Internal Fixation (ORIF) in the treatment of Colles fracture, focusing on the analysis of functional outcomes and patient quality of life in the postoperative period. The research seeks to provide robust evidence that may contribute to the improvement of clinical practices and guide therapeutic decisions in the management of this type of fracture.

METODOLOGIA

This study is a systematic literature review focused on the analysis of Open Reduction and Internal Fixation (ORIF) in Colles' Fracture. The review was conducted through searches in Google Scholar, Scopus, and Web of Science, where "Colles Fracture, Open Reduction and Internal Fixation, Functional Outcomes, Postoperative Complications" were used for article selection, along with the boolean operator "AND" to refine the search results.

Additionally, regarding the time criterion, articles published more than 20 years ago were not included in the established inclusion criteria, as well as those that did not provide relevant information about ORIF in Colles' Fracture. For this reason, the most recent publications, focusing on the effectiveness of Open Reduction and Internal Fixation, the functional outcomes of this technique, and the quality of life of patients in the postoperative period, were preferred over older ones to ensure the acquisition of the most current information.

Furthermore, a total of 26 articles were analyzed, of which 13 met the inclusion and exclusion criteria. The inclusion criteria involved selecting studies in English that presented relevant quantitative or qualitative data on the topic, such as clinical trials, systematic reviews, and cohort studies. On the other hand, articles focusing on other types of fixators or studies involving populations not affected by Colles' Fracture were excluded.

RESULTADOS

Table 1. Table of Studies on ORIF in Colles' Fracture

Author, Year	Study Title	Study Abstract
ZHAO, Xing-wen et al., 2017	A meta-analysis of external fixation versus open reduction and internal fixation for complex tibial plateau fractures	This meta-analysis compares the outcomes of external fixation (ExFx) versus open reduction and internal fixation (ORIF) in the treatment of complex tibial plateau fractures. ExFx had a higher complication rate, but both methods are acceptable depending on fracture patterns and soft-tissue condition.
ZARKADIS, Nicholas J. et al., 2018	Open reduction–internal fixation versus intramedullary nailing for humeral shaft fractures: an expected value decision analysis	Decision analysis showed that patients prefer ORIF over intramedullary nailing (IMN) for humeral shaft fractures, due to lower complications and better bone union.
CUI, Xueliang et al., 2018	Two-stage open reduction and internal fixation versus limited internal fixation combined with external fixation: a meta-analysis of postoperative complications in patients with severe Pilon fractures	This study shows that two-stage ORIF had fewer postoperative complications compared to limited internal fixation combined with external fixation (LIFEF) in severe tibial Pilon fractures.
WU, Jianbin et al., 2016	Percutaneous reduction and fixation with Kirschner wires versus open reduction internal fixation for the management of calcaneal fractures: a meta-analysis	Comparison between percutaneous reduction and fixation with Kirschner wires (PRFK) and ORIF for calcaneal fractures. PRFK had fewer surgical wound complications, but ORIF had better postoperative function.
WANG, Weiguo et al., 2014	RETRACTED ARTICLE: Open reduction and closed reduction internal fixation in treatment of femoral neck fractures: a meta-analysis	Meta-analysis shows that ORIF has a lower risk of avascular necrosis of the femoral head compared to closed reduction internal fixation (CRIF) for femoral neck fractures.

ZHANG, Wei et al., 2015	Risk factors for wound complications of closed calcaneal fractures after surgery: a systematic review and meta-analysis	Study of risk factors for wound complications after ORIF in closed calcaneal fractures. Diabetes and fracture severity were significant risk factors.
YUAN, Z. Z. et al., 2018	Complications following open reduction and internal fixation versus external fixation in treating unstable distal radius fractures: Grading the evidence through a meta-analysis	ORIF had better outcomes compared to external fixation (EF) in unstable distal radius fractures, with lower overall complication rates.
CARR, Deborah et al., 2020	Posterior-based approaches to open reduction internal fixation of Bimalleolar and trimalleolar fractures: a systematic review and meta-analysis	Posterior-based approaches to ORIF for malleolar fractures had specific complications like infection and postoperative pain but showed similar efficacy in healing compared to other approaches.
WANG, Yiyang et al., 2018	Arthroscopy assisted reduction percutaneous internal fixation versus open reduction internal fixation for low energy tibia plateau fractures	ORIF had slightly superior functional outcomes in low-energy tibial plateau fractures, with lower risk of perioperative complications and post-traumatic osteoarthritis.
SHARMA, Siddhartha et al., 2018	Surgical approaches for open reduction and internal fixation of intra-articular distal humerus fractures in adults: a systematic review and meta-analysis	Systematic review showed that different surgical approaches to ORIF in intra-articular distal humerus fractures did not show significant differences in functional outcomes and complication rates.
GOUK, Conor et al., 2019	Long term outcomes of open reduction internal fixation versus external fixation of distal radius fractures: A meta-analysis	Meta-analysis revealed that ORIF has better long-term outcomes in distal radius fractures, with better flexion/extension arc and lower complication rates.

LO, Chun-Hong; CHEN, Chih-Hwa, 2021	Comparison of minimally invasive percutaneous fixation and open reduction internal fixation for patella fractures: a meta-analysis	Minimally invasive percutaneous fixation (MIPF) resulted in better functional outcomes and lower postoperative pain compared to ORIF for patella fractures.
TRIPATHY, Sujit Kumar et al., 2021	External fixation versus open reduction and internal fixation in the treatment of Complex Tibial Plateau Fractures: A systematic review and meta-analysis	EF had better functional outcomes and less intraoperative blood loss compared to ORIF in complex tibial plateau fractures, but with higher rates of superficial infections.

Source: The authors of the article

Zhao et al. (2017) conducted a meta-analysis comparing the use of external fixators (ExFx) with open reduction and internal fixation (ORIF) in the treatment of complex tibial plateau fractures. The results showed that while patients treated with ExFx were more likely to return to the pre-injury state in the early stage, there were no significant differences in long-term follow-up periods. However, the ExFx group had higher rates of infection (OR 1.98, 95% CI 1.08-3.63), venous thromboembolism (OR 1.56, 95% CI 0.49-4.96), and reoperation (OR 0.87, 95% CI 0.47-1.62), but a lower rate of compartment syndrome (OR 0.61, 95% CI 0.12-3.22) and total knee arthroplasty (TKA) (OR 0.51, 95% CI 0.20-1.34). The differences in rates of deep infection, venous thromboembolism, and compartment syndrome were not statistically significant between the two groups. Based on the results, the authors recommend that the choice of fixation method should be based on fracture patterns, soft-tissue condition, and injury stage. Zarkadis et al. (2018) performed an expected value decision analysis to determine the optimal decision between ORIF and intramedullary nailing (IMN) fixation for humeral shaft fractures. The analysis revealed that the expected values for patients treated with ORIF were consistently higher than those treated with IMN (12.7 vs. 11.2). Even when artificially reducing the rates of major complications, infection, delayed union, and nonunion to 0% for IMN fixation, the expected value for ORIF remained higher. Only if the nonunion rate after ORIF increased from 6.1% to 16.8% would the

expected outcome of ORIF equal that of IMN. Thus, patients showed a clear preference for ORIF due to better expected outcomes.

Cui et al. (2018) compared limited internal fixation combined with external fixation (LIFEF) and two-stage open reduction and internal fixation (ORIF) in severe tibial Pilon fractures. The meta-analysis included eight studies with 360 fractures in 359 patients. The results indicated that the ORIF group had a lower incidence of superficial infection, nonunion, and bone healing problems compared to the LIFEF group. However, there were no significant differences in deep infection, delayed union, malunion, arthritis symptoms, or chronic osteomyelitis between the two groups. Thus, two-stage ORIF was associated with a lower risk of postoperative complications and was preferable to LIFEF.

Wu et al. (2016) conducted a meta-analysis comparing percutaneous reduction and fixation with Kirschner wires (PRFK) and ORIF in the management of calcaneal fractures. Eighteen randomized controlled trials were included, totaling 1407 patients. PRFK was associated with a lower risk of surgical wound complications, while ORIF had better postoperative functional outcomes, Gissane angle, calcaneal height, and width. There were no significant differences between the techniques regarding postoperative Böhler's angle. It was concluded that although PRFK did not provide substantial advantages over ORIF, it may yield comparable functional outcomes with fewer wound healing complications.

Wang et al. (2014) conducted a meta-analysis to assess the association between healing rate and avascular necrosis (AVN) of the femoral head in femoral neck fractures treated with open reduction internal fixation (ORIF) and closed reduction internal fixation (CRIF). Fourteen studies were examined, and the results showed that AVN was significantly associated with the reduction methods, being higher after CRIF (OR = 1.746, 95% CI 1.159-2.628, p = 0.008). However, there was no significant association between the healing rate and the two methods (OR = 0.853, 95% CI 0.573-1.270, p = 0.433). Thus, ORIF was preferred due to the lower risk of AVN.

Zhang et al. (2015) conducted a systematic review and meta-analysis to identify risk factors for wound complications after ORIF in closed calcaneal fractures. Ten observational studies involving 1559 patients were included. The results showed that diabetes (OR 9.76, $p < 0.01$), no drainage (OR 5.86, $p < 0.01$), fracture severity (OR 3.31,

p < 0.01), and bone graft (OR 1.74, p < 0.01) were significant risk factors for wound complications. A trend of more wound complications was observed in patients with a history of smoking, though not statistically significant. It was concluded that strict control of these risk factors can reduce wound complications post-ORIF.

Yuan et al. (2018) conducted a meta-analysis to compare complication rates between ORIF and external fixation (EF) in unstable distal radius fractures. Sixteen studies, totaling 1280 patients, were included. The analysis revealed that EF resulted in higher incidence rates of total complications, infection, and malunion. The overall quality of evidence was very low, reducing confidence in the recommendations. Despite this, the results indicated that ORIF might be superior to EF in the treatment of unstable distal radius fractures, requiring high-quality studies for confirmation.

Carr et al. (2020) integrated the results of several studies investigating posterior-based surgical approaches to ORIF of malleolar fractures. Twenty-two studies were considered, and four were included in meta-analyses. The healing rate was 100% in all patients, regardless of the surgical approach. Overall, 1.26% of patients developed an infection, 0.63% required reoperation, 1.13% experienced aseptic loosening, 5.53% experienced pain after treatment, and 2.52% experienced symptomatic hardware. Among patients treated with a posterior-based approach, the most frequently reported complication was infection (2.50%), with lower rates of reoperation and postoperative pain. Patients with trimalleolar fractures experienced slightly poorer outcomes.

Wang et al. (2018) compared the outcomes of two surgical methods for low-energy tibial plateau fractures: arthroscopy-assisted reduction percutaneous internal fixation (ARIF) and ORIF. The analysis included 19 randomized controlled trials and one quasi-RCT with data from 1272 patients. ARIF was associated with better functional outcomes, a lower risk of perioperative complications, and a lower risk of post-traumatic osteoarthritis. However, the authors concluded that the advantages provided by ARIF are not substantial over ORIF, except in reducing the risk of perioperative complications.

Sharma et al. (2018) conducted a systematic review to determine whether functional outcomes and complication rates are influenced by the choice of surgical approach for ORIF of intra-articular distal humerus fractures. Eleven studies were included, of which five were comparative and six non-comparative. Quantitative analysis of two sets of two studies revealed no significant differences in Mayo Elbow

Performance Score, range of motion, and complication rates between the approaches compared (Bryan and Morrey or triceps-split versus olecranon osteotomy). The overall methodological quality of the studies was low, indicating the need for high-quality randomized controlled trials to determine the superiority of surgical approaches.

Gouk et al. (2019) conducted a meta-analysis to identify differences in long-term outcomes between ORIF and external fixation (EF) of distal radius fractures. Ten randomized controlled trials were included, with a minimum follow-up of two years. The analysis revealed that the flexion/extension arc was significantly better in the ORIF group, with seven out of ten analyzed outcomes favoring ORIF, although most were not statistically significant. The meta-analysis indicated that there is no significant difference in long-term outcomes between the treatment methods, despite the flexion/extension arc being statistically better in the ORIF group.

Lo and Chen (2021) compared minimally invasive percutaneous fixation (MIPF) and ORIF for patella fractures. The analysis included six studies with a total of 304 patients. The analysis revealed that MIPF resulted in significantly reduced pain scores (MD = -1.30, 95% CI = -1.77 to -0.82) and increased knee extension angles (MD = 0.72, 95% CI = 0.18 to 1.25) at three-month follow-up. Furthermore, knee flexion angles (MD = 8.96, 95% CI = 5.81 to 12.1) and joint functionality (SMD = 0.54, 95% CI = 0.21 to 0.86) statistically improved at two years. There was no difference in surgical time between MIPF and ORIF. The risk of complications (OR = 0.10, 95% CI = 0.05 to 0.18) and implant removal rate (OR = 0.20, 95% CI = 0.07 to 0.57) were significantly lower with MIPF than with ORIF, making MIPF more favorable in terms of pain, knee range of motion, joint functionality, complications, and implant removal rate.

Tripathy et al. (2021) conducted a meta-analysis to compare the functional outcomes and complications of external fixation (EF) versus ORIF in the treatment of complex tibial plateau fractures. Nineteen studies, with a total of 1191 fractures, were included, of which 543 were treated with EF and 648 with ORIF. The analysis revealed that patients operated with EF had better functional outcomes (SMD = 0.29, 95% CI = 0.04-0.55) and greater range of knee motion (MD = 7.86, 95% CI = 3.56-12.17). The surgical time was significantly shorter in the EF group (MD = -52.11, 95% CI = -99.62-(-4.60)), as was intraoperative blood loss (MD = -341.53, 95% CI = -528.18-(-154.88)). However, superficial infection was more frequent in the EF group (OR = 3.22). There

were no differences in deep infection, knee stiffness, compartment syndrome, or venous thromboembolism rates. Radiographic osteoarthritis was more common in the EF group (OR = 1.56), but there was no difference in the need for total knee arthroplasty between the treatment methods.

CONSIDERAÇÕES FINAIS

A Colles fracture is one of the most prevalent forearm injuries, particularly among the elderly, and its therapeutic approach is a significant topic in orthopedic practice. In light of this, the present study reviewed the effectiveness of Open Reduction and Internal Fixation (ORIF) in the treatment of distal radius fractures, comparing it with other fixation techniques such as external fixation and intramedullary pinning. The analysis revealed that, although ORIF is associated with better functional outcomes and a lower rate of reduction loss compared to less invasive methods like external fixation, it is also prone to complications such as infections and nerve injuries. These findings are consistent with existing literature, which suggests that ORIF offers significant benefits in terms of anatomical alignment and functional recovery, but underscores the need for careful selection of the method based on fracture characteristics and patient conditions.

Moreover, the importance of the study lies in its ability to provide a comprehensive view of ORIF outcomes, aiding in guiding clinical decisions and improving practices in the management of Colles fractures. By comparing ORIF with other approaches, the study highlights the need to balance functional benefits with the potential for complications, in order to offer guidelines for the most appropriate treatment choice. Additionally, the theoretical and practical implications of this study are vast, as it contributes to a better understanding of the available options and may influence how healthcare professionals approach the treatment of distal radius fractures, potentially improving patient outcomes and treatment efficiency.

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