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Original Research

Assessment of Fracture Neck Femur Treatment: A Comparative Analysis of Fibular Grafting and Cancellous Hip Screws

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ABSTRACT:

Background:The current investigation aims to assess the efficacy of utilizing a fibular graft in conjunction with supplementary fixation devices, such as cancellous hip screws. This study seeks to explore both the benefits and drawbacks of this approach in managing closed fractures of the femoral neck.**Methods**:A total of 72 patients were included in this study, and a retrospective analysis was conducted on prior cases involving the treatment of femoral neck fractures using fibular grafts and cancellous hip screws. Upon admission, a thorough assessment of each patient was performed, with specific attention given to identifying any associated injuries or medical conditions. If deemed necessary based on the patient's condition, pre-operative measures were taken, including immobilization of the fractured limb using upper tibial pin traction or above-knee skin traction. Standard blood and urine examinations were conducted, addressing any identified medical conditions. Following these preparations, the patient underwent a pre-anesthetic check-up and was scheduled for surgery at the earliest possible time.**Results**:Our study yielded satisfactory outcomes, with 26 cases in group I and 18 cases in group II showing positive results. However, in 4 cases of group I, the fractures united in malposition, leading to noticeable joint motion restrictions or early avascular necrosis, causing pain during exertion. Similarly, in 8 cases of group II, fractures united in malposition, resulting in appreciable joint motion restrictions or early avascular necrosis leading to exertion-related pain. Additionally, 4 fractures in group I failed to unite, and in 2 cases, extensive avascular necrosis of the head caused severe rest pain and significant impairment of function.**Conclusion**:Hence, our conclusion is that fibular grafting procedures for intracapsular fractures of the femoral neck yield positive outcomes when executed with meticulous technical precision. This approach provides effective stability, particularly in cases of femoral neck fractures with posterior comminution—a common occurrence where metallic fixation devices are prone to losing their stability.

Keywords:Fibular grafting, Fracture neck femur, Cancellous hip screw, Avascular necrosis.

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INTRODUCTION

Fractures occurring in the femoral neck among young individuals are frequently attributed to high-energy trauma, and managing these injuries poses a considerable challenge for surgeons. This difficulty stems from the heightened probability of avascular necrosis (AVN) affecting the femoral head and the increased risk of nonunion associated with such fractures[1]. The vulnerability of the femoral head to AVN is underscored by an incidence ranging from 0% to 65%, indicative of the complex and multifaceted nature of these injuries.Nonunion in femoral neck fractures compounds the treatment complexity, with reported rates as high as 43% in some patient populations and reaching up to 59% in specific series. The intracapsular nature of these fractures introduces additional challenges, with factors such as angiogenesis inhibitors present in synovial fluid and the absence of a cambium layer being implicated in the development of nonunion[2].A noteworthy aspect in addressing these challenges involves the application of fibular grafts, both vascularized and non-vascularized. Several studies have demonstrated significant success rates, particularly when utilizing the Harris hip score as a metric. In cases of osteonecrosis of the femoral head, these studies reveal

a remarkable 70% success rate with fibular grafts compared to a less favorable 39% success rate with alternative treatment approaches. This highlights the promising potential of fibular grafting techniques in mitigating the complications associated with femoral neck fractures in young individuals, emphasizing the need for meticulous surgical skill and thoughtful consideration of the intricate factors at play in achieving favorable outcomes[3].The successful treatment of femoral neck fractures hinges on a complex interplay of various factors, with distinct elements falling both within and beyond the control of the surgeon. The extent of injury, characterized by parameters such as the degree of displacement, the presence of comminution, and the status of circulation, constitutes a critical set of variables that significantly influence treatment outcomes. Notably, these factors lie beyond the direct influence of the surgeon, emphasizing the inherent challenge of managing variables that are often intrinsic to the injury itself.Conversely, there are aspects of the treatment process that squarely fall under the control of the surgeon. The adequacy of reduction, the precision with which fractured components are realigned, and the choice of fixation methods are pivotal determinants in shaping the success of the intervention. This places a considerable responsibility on the surgeon to employ meticulous techniques and make informed decisions to optimize outcomes[4].In the context of elderly patients, the landscape of femoral neck fracture treatment has evolved, with replacement surgery—whether total or partial—emerging as the preferred therapeutic approach. However, the journey towards identifying the most effective treatment strategy for relatively younger patients persists, akin to a quest that has endured over decades and remains as pressing today as it was half a century ago.Despite remarkable advancements in both technical and biomechanical aspects within the field of Orthopaedics, accompanied by a proliferation of implants boasting heightened stability and inert characteristics, the pursuit of the ideal fixation device continues. The ultimate objective remains the achievement of a robust union and the facilitation of early mobility for patients. It's crucial to recognize that, regardless of an implant's inert properties, its status as a foreign body introduces inherent challenges, with implant-bone interface loosening being a recurrent issue that often leads to implant failure[5]. This complex dynamic adds another layer of intricacy to the already challenging landscape of treating femoral neck fractures, underscoring the perpetual need for ongoing advancements in fixation devices to enhance outcomes in this demanding clinical scenario.The treatment strategy for closed femoral neck fractures utilizing a fibular graft is rooted in a multifaceted rationale aimed at optimizing the healing process. The intervention is designed to address various aspects of the fracture pathology, including decompression of the femoral head to disrupt the ischemic cycle and interosseous hypertension. Additionally, the removal of necrotic bone creates a more conducive environment for healing. The introduction of fresh cortico-cancellous bone through grafting aims to fill the defect, providing structural support to enhance stability. Placement of a viable cortical bone strut strategically supports the subchondral surface, mitigating the risk of collapse and preserving joint integrity. Moreover, the fibular graft serves as a source of mesenchymal stem cells, promoting the revascularization process vital for optimal healing. Significantly, the strategy aims to circumvent and alter the foreign body response, reducing the likelihood of adverse reactions[6,7]. The ongoing study endeavors to systematically assess the effectiveness of this approach, particularly when combined with supplementary fixation devices such as cancellous hip screws, thereby shedding light on its advantages and disadvantages in the treatment of closed femoral neck fractures.

MATERIALS AND METHODS

In a cohort comprising 72 patients, our study involved a retrospective analysis of past cases involving the treatment of femoral neck fractures through the application of fibular grafting and cancellous hip screws. The investigative process commenced with a meticulous evaluation of each patient upon admission, with a particular focus on identifying associated injuries and concurrent medical illnesses. For cases necessitating pre-operative preparation, a fracture-specific immobilization approach was implemented, utilizing upper tibial pin traction or above-knee skin traction.Furthermore, comprehensive blood and urine examinations were conducted as part of routine pre-operative assessments. Any identified associated medical conditions were addressed appropriately to ensure the overall health and well-being of the patients. Subsequently, each patient underwent a thorough pre-anesthetic check-up, ensuring their suitability for surgery. Following this evaluation, patients were promptly scheduled for surgery to address the femoral neck fracture at the earliest feasible time. This systematic approach aimed to optimize patient care by considering associated factors, preparing patients adequately, and expediting the surgical intervention for enhanced treatment outcomes.

Our study employed meticulous criteria for case selection, encompassing a broad inclusion of all patients with femoral neck fractures, regardless of age or duration since trauma. However, certain exclusions were defined to refine the cohort and enhance the study's validity. Patients exhibiting conditions impeding postoperative cooperation, such as psychosis, mental retardation, parkinsonism, or residual hemiplegia and spasticity resulting from a cerebrovascular accident, were excluded. Additionally, individuals with unstable skin conditions, including blebs, infected abrasions, burns,

or bed sores, were not included, recognizing the potential impact on surgical and postoperative management[8]. The exclusion of patients identified as poor candidates for anesthesia and those with a projected life expectancy of less than two years highlights the importance of considering overall health and aligning treatment strategies with anticipated outcomes. These criteria collectively aimed to create a focused and clinically relevant cohort, ensuring the study's findings are applicable to a population that can actively participate in postoperative rehabilitation and derive maximum benefit from the intervention.The surgical procedure for the treatment of femoral neck fractures involved meticulous steps conducted under aseptic conditions and with appropriate anesthesia. Closed reduction of the fracture was initially attempted using either the Whitmann's lead batter or Flynn method, and the outcomes were assessed through check AP and lateral radiographs obtained with a C-Arm fluoroscopic unit. In cases where closed reduction proved ineffective, an open reduction was then undertaken.

For the fibular harvest, the donor site, ideally located on the contralateral leg, was chosen for ease of operation involving two separate teams. The standard Henry's posterolateral approach was employed to expose the fibular shaft. The desired length of the fibula, determined by the length of the guide wire within the proximal femur, was then excised through osteotomy using an osteotome or Giglis saw, with drill holes made at the desired ends. Following closure of the wound in layers, the freshly harvested fibular graft underwent denudation of all soft tissue attachments. To facilitate insertion into the head and neck of the femur, one end of the graft was beveled. Notably, the fibular graft was utilized immediately after removal without any preservation measures.

The placement of the fibular graft involved careful insertion with the broadest surface in the AP plane, utilizing gentle impaction. Before impaction, a final cancellous plug was positioned in the distal aspect of the tunnel. The confirmation of the final graft position was verified, and the fluoroscope unit was subsequently removed. This comprehensive surgical approach aimed to address femoral neck fractures through a combination of closed reduction attempts, open reduction when necessary, and the immediate utilization of a freshly harvested fibular graft to optimize stability and facilitate the healing process.

RESULTS

In this comprehensive study, a total of 84 cases of intracapsular femoral neck fractures were included, incorporating both prospective and retrospective analyses. Among the prospective cases (42 in total), the treatment approach involved fibular grafting along with fixation using cannulated cancellous hip screws. However, 12 cases from the prospective group were lost to follow-up and consequently excluded from the results evaluation. The retrospective analysis component of the study (24 cases) focused on femoral neck fractures that had been previously treated using cannulated cancellous hip screws, specifically employing a configuration of four parallel screws.The dual approach—prospective cases involving fibular grafting and retrospective cases with cannulated cancellous hip screws—allowed for a comprehensive assessment of the outcomes in the context of intracapsular femoral neck fractures. The inclusion of both prospective and retrospective data provides a valuable perspective on the effectiveness and implications of these distinct treatment modalities, offering insights into their respective merits and outcomes. The exclusion of cases lost to follow-up reflects the study's commitment to a robust and reliable evaluation of the results.

Table 1: Age Incidence

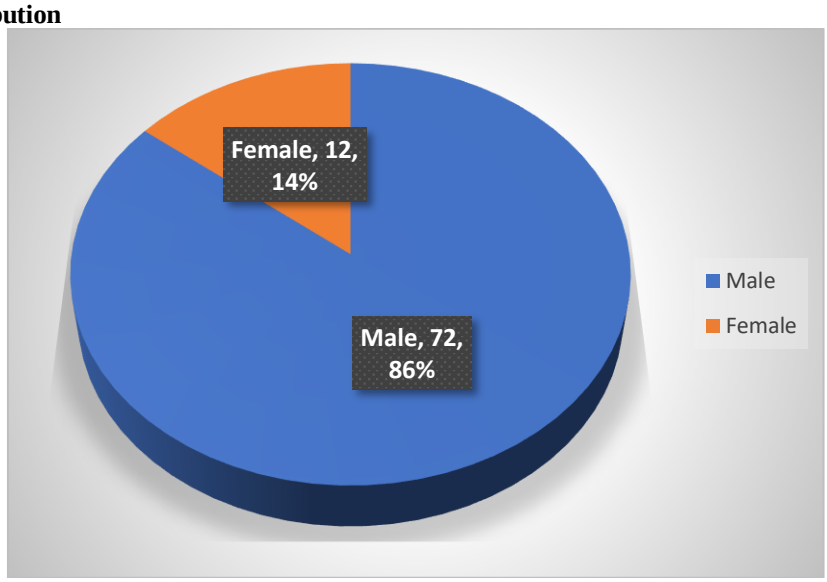
Age (Years)	No. of Patients
11-20	12 (14.28%)
21-30	36 (42 88%)
31-40	16 (19.04%)
41-50	12 (14.28%)
51-60	8 (9.32%)
Total	84 (100%)

In this study, the patient cohort exhibited a broad age range, with the minimum age set at 18 years and the maximum at 60 years. The mean age across the series was calculated to be 28.33 years. Notably, the incidence of femoral neck fractures displayed a relatively even distribution across multiple decades, spanning from the second to the sixth. However, the data revealed a peak incidence occurring within the third decade, suggesting that individuals in their thirties experienced a higher frequency of these fractures compared to other age groups. This age-wise distribution provides a valuable demographic context, contributing to a comprehensive understanding of the prevalence and characteristics of femoral neck fractures within the studied population.

Table 2: Sex distribution

Sex	No. of Patients.
Male	72 (85.71%)
Female	12 (14.29%)
Total	84(100%)

Fig1: Sex distribution



This study identified a robust male preponderance among the participants. The data revealed a significant and notable predominance of male individuals in the cohort under investigation. This observation underscores a gender-related pattern in the incidence of femoral neck fractures, suggesting that males were more prominently affected than their female counterparts. Such findings contribute to our understanding of the demographic aspects of femoral neck fractures, potentially prompting further exploration into the underlying factors contributing to this observed gender disparity within the studied population.

Table 3: Mode of Trauma

Age(years)	No. of Cases	Tumble	Fall	RTA
11-20	12	-	4	8
21-30	36	-	8	28
31-40	16	-	6	10
41-50	12	2	6	
51-60	8	4	2	12
Total	84(100%)	6 (7.14%)	26(30.95%)	52 (61.91%)

Fig2: Mode of Trauma

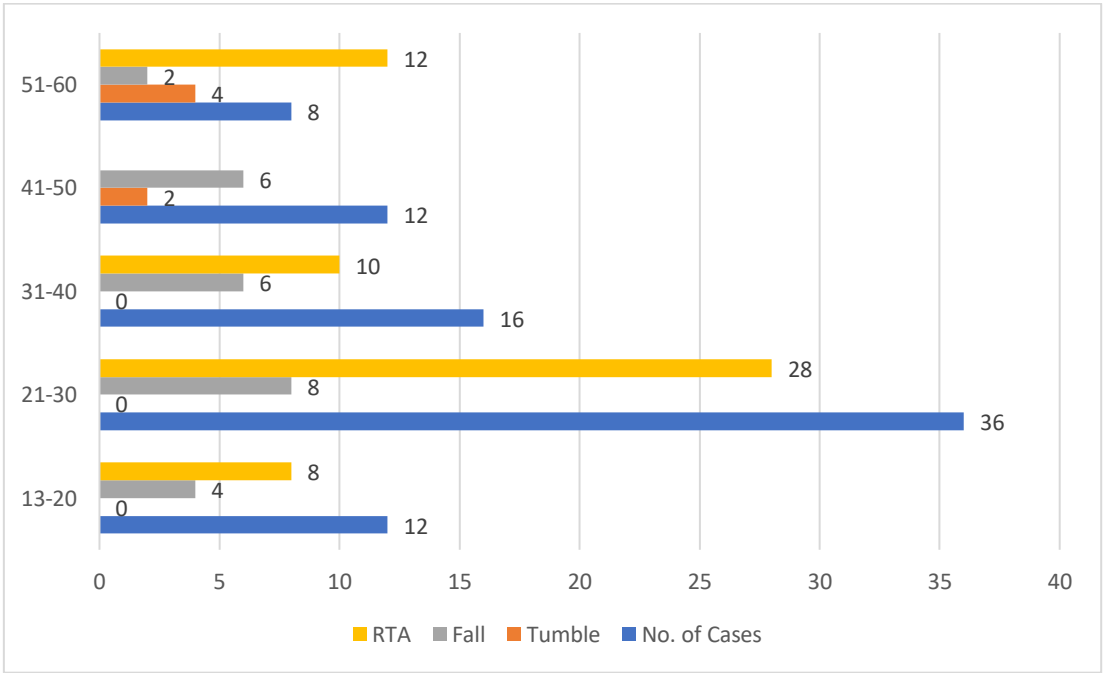


Table 4: Final Results

Results	Group-1	Group-2
Excellent	20 (55.52%)	10 (27 74%)
Good	6(16.68%)	8 (22.22744)
Fair	4 (11.12%)	12 (33.36%)
Poor	6 (16.68%)	6(16.68%)
Total	36 (100%)	36 (100%)

DISCUSSION

The challenge posed by intracapsular femoral neck fractures has been historically acknowledged as an "unsolved" or "unsolvable" fracture, as noted by Dickson (1953) and Barnes (1964), respectively. This classification has persisted, representing an enduring conundrum for orthopedic surgeons globally. Bonfiglio and Bardenstein[9] attempted to address this complex issue by performing surgeries on 60 patients with aseptic necrosis of the femoral head, with or without non-union of the femoral neck. Their method involved the insertion of two cortical autogenous grafts, resulting in 75% satisfactory outcomes. They underscored the critical importance of accurate graft placement and advocated against early weight-bearing to prevent complications. Their approach was particularly lauded for preserving and restoring the femoral neck and the viability of the femoral head due to its estrogenic nature.In the current study, two cases exhibited avascular necrosis, one of which was operated on more than six weeks after the trauma. Notably, a case with Garden's Grade IV fracture and another with Garden's Grade II fracture presented after eighteen months with avascular necrosis, despite initial union within three months. Trueta's[10] hypothesis regarding fixation in coxa vara leading to undue stress on the lateral epiphyseal vessel, eventually resulting in avascular necrosis, found support in the present findings. The degree of initial displacement of the fracture appeared to elevate the risk of avascular necrosis, as cases with avascular necrosis were predominantly classified as Garden's Grade III or Grade IV fractures. However, no significant correlation was observed between the operative procedure and avascular necrosis.Two cases failed to unite at the final follow-up, both accompanied by pain impeding daily routines. One patient with a Garden's Grade V fracture, operated on nine days post-trauma, experienced non-anatomical reduction, possibly contributing to graft breakage and subsequent failure. Despite this, the union between fibular grafts and the trochanteric site, as well as the well-positioned graft and the head and neck, remained robust. This presented challenges during subsequent surgeries, such as femoral head removal and medullary cavity reaming during hemiarthroplasty for avascular necrosis and a painful hip. These findings underscore the persistent complexity and multifactorial nature of treating intracapsular femoral neck fractures, highlighting the need for ongoing advancements in surgical techniques and management strategies[11].In the course of this study, certain cases presented a unique challenge due to their chronic nature, leading to a distinctive set of complications during the surgical procedures. Specifically, encounters of the fibular graft and cannulated cancellous hip screw during surgery resulted in distraction at the fracture site, ultimately contributing to non-union. It is intriguing to note that a comparable fixation approach reported by Thomas King (1937) demonstrated no instances of implant loosening or failure. Previous observations by Wardle (1945) and Patrick (1949) underscored the phenomenon of early fibular union with the cancellous bone of the femoral head and trochanter, effectively preventing the collapse of the neck and promoting successful union.

Intriguingly, two cases in the study exhibited persistent ankle edema in the early postoperative period, proving resistant to conventional measures such as crepe bandaging and limb elevation. The potential association with pre-operative damage to the peroneal vein, responsible for draining the periankle area, as emphasized by Chacha et al[12] in their work on vascularized fibular grafts, adds a layer of complexity to the understanding of this phenomenon.The age of the patients emerged as a significant factor influencing the outcomes, demonstrating an inverse relationship. This aligns with the observations made by Marti et al, who attributed such age-related variations to osteoporosis, resulting in diminished stability and a potential loss of reduction during postoperative physiotherapy programs.

Overall, the study yielded satisfactory results in 72.2% of cases, with excellence achieved in 55.2% and a good outcome in 16.68%. Fracture union occurred in a majority of cases (88.88%), although complications such as shortening were observed in a noteworthy percentage (33.33%) of cases where union was successful[13]. These comprehensive findings shed light on the intricate challenges and diverse outcomes associated with the specific fixation method employed in the treatment of femoral neck fractures, emphasizing the need for a nuanced understanding and tailored approaches to address the multifaceted nature of these orthopedic cases.

In the current study, the higher rate of failure observed in Garden's Grade IV fractures could potentially be attributed to factors such as inadequate or improper reduction, or a lack of proper X-ray control[14]. The complexity of Grade IV fractures, which involve significant displacement and comminution, poses challenges in achieving optimal reduction and fixation. Similar challenges were noted by Cleveland

(1959), who reported an overall failure rate of 20% when utilizing a lag device.

In contrast, cases of femoral neck fractures treated with a combination of fibular grafting and cannulated cancellous screw fixation were observed to have a higher likelihood of union and reduced functional disability. This observation aligns with the findings of Clark et al[15], who suggested that the approach of fibular grafting combined with cannulated cancellous screw fixation may offer superior outcomes compared to cases treated solely with cannulated cancellous screw fixation.The emphasis on accurate valgus reduction, surgical impaction, and rigid internal fixation has been highlighted by Deyerle et al (1959). Their emphasis on these factors underscores the importance of precise surgical techniques to ensure optimal alignment and stability during the fixation process. Furthermore, Deyerle's refinement of pin fixation techniques, utilizing a sophisticated system of 9-11 pins sliding through a heavy side plate in 1966, signifies ongoing efforts to enhance the mechanical aspects of fixation, aiming for improved outcomes in the treatment of femoral neck fractures.

CONCLUSION

The study's findings provide compelling insights into the effectiveness of fibular grafting procedures for intracapsular femoral neck fractures. Executed with meticulous technical skill, these procedures demonstrate positive outcomes, particularly offering enhanced stability in cases involving posterior comminution—a common challenge where other metallic fixation devices may falter. Notably, fibular grafting proves valuable not only in fresh fractures but also in older cases where the femoral head remains viable. A significant advantage emerges in the prevention of bone absorption at the metal-bone interface, a frequent issue leading to implant loosening and collapse in alternative fixation methods. The early union of the fibula with the head and trochanter, enriched with cancellous bone, plays a crucial role in averting collapse. Furthermore, when compared to fixation with only a cannulated cancellous hip screw, fibular grafting combined with a cannulated cancellous screw emerges as a superior approach, showcasing excellent overall results and stability. These conclusions collectively underscore the multifaceted benefits of fibular grafting, positioning it as a promising intervention for intracapsular femoral neck fractures.

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