Type of article: Original

Epidemiology of perioperative problems associated with implant removal: A Prospective Study

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Abstract:

Implant removal is a common surgical procedure, but it is associated with various intraoperative and postoperative challenges. This prospective observational study aimed to investigate the epidemiology of problems faced during and after orthopedic implant removal surgeries. This single-center study included 70 participants who underwent orthopedic implant removal. Intraoperative and postoperative complications were recorded, and risk factors were analyzed using univariate and multivariate analyses. The most common type of implant removed was Femur and Tibia Nails accounting for 14.2% of cases (n=10), followed by TENS (at 14.2%; n=10), K wires & CC Screws (at 12.8%; n=9), Proximal tibia fracture (at 11.4%; n=8), TBW in Patellar Fracture (at 10.0%; n=7), Clavicle Fracture (at 10.0%; n=7), DER Plates in Distal Radius Fracture (at 8.57%; n=6), CC screws & fibular plates in bimalleolar fractures (at 8.57%; n=6), 3.5 DCP in both bone forearm fracture (at 7.14%; n=5) and DHS in IT Fracture (at 4.28%; n=3). Intraoperative complications were reported in 35.7% of cases, with the most frequent being difficulty in implant extraction (34.3%), extensive tissue dissection (21.4%), and the need for additional surgical interventions (17.1%). Postoperative complications occurred in 62.9% of the cohort, including wound healing issues (30%), infections (21.4%), and hematoma formation (20%). Osteoporosis, longer duration of implantation, obesity, and chronic pain syndrome were identified as significant risk factors for intraoperative complications. Age, diabetes, and longer surgical duration were associated with an increased risk of postoperative complications. This study provides comprehensive insights into the epidemiology of problems faced intraoperatively and postoperatively during orthopedic implant removal procedures. The findings highlight the significant incidence of complications and the importance of risk stratification and individualized management strategies to optimize patient outcomes.

Keywords: Orthopedic implant removal, intraoperative complications, postoperative complications, risk factors, management strategies.

1. Introduction

Implant removal is a common surgical procedure performed in various medical specialties, including orthopedics, plastic surgery, and general surgery.[1] The decision to remove an implant can be influenced by several factors, such as the development of complications, the need for revision surgery, or the patient's personal preference. [2] Regardless of the reason, implant removal surgery carries inherent risks and can be associated with intraoperative and postoperative challenges.

The epidemiology of problems faced during and after implant removal surgery is an important area of study, as it can help healthcare providers identify and mitigate potential complications, improve patient outcomes, and optimize the overall management of these procedures.[3] One of the most common intraoperative challenges encountered during implant removal is the difficulty in extracting the implant, particularly in cases where the implant has become well-integrated into the surrounding tissue or has undergone significant deformation.[4] This can lead to prolonged surgical time, increased risk of extensive tissue dissection, and the potential need for additional surgical interventions. Additionally, the presence of scar tissue, adhesions, or anatomical distortions can further complicate the surgical procedure and increase the risk of intraoperative complications.

Postoperative complications following implant removal can also be significant and may include infection, wound healing issues, hematoma formation, neurological deficits, and persistent pain or discomfort. [5] These complications can not only impact the patient's recovery and quality of life but also lead to increased healthcare costs and the need for additional interventions. Several factors have been identified as potential risk factors for the development of intraoperative and postoperative problems in implant removal surgeries. These include the type and location of the implant, the duration of implantation, the patient's age and comorbidities, and the surgical technique employed. [6] Understanding the influence of these factors is crucial for developing effective strategies to prevent and manage these complications.

The primary objective of this prospective observational study was to investigate the epidemiology of problems faced intraoperatively and postoperatively during implant removal surgeries. Specifically, the study aimed to determine the incidence of intraoperative and postoperative complications, identify the risk factors associated with these complications, and evaluate the management strategies employed to address them.

2. Material and Methods

This prospective study was conducted at a single tertiary care center over a period of two years. The study sample included 70 patients who underwent implant removal surgery during the study period and met the inclusion criteria. The inclusion criteria were adult and paediatric patients (aged 5 years or older) who underwent elective implant removal surgery, regardless of the type or location of the implant. Patients with emergency implant removal procedures, those with incomplete medical records, and those who declined to participate in the study were excluded.

All participants underwent a thorough pre-operative assessment, including a detailed medical history, physical examination, and radiographic evaluation. Intraoperative data, including the type and location of the implant, the duration of the surgery, and any intraoperative complications, were meticulously recorded by the operating surgeon. Postoperatively, patients were closely monitored for the development of any complications, such as wound healing issues, infection, hematoma formation, neurological deficits, or persistent pain. The management strategies employed to address these complications were also documented.

Data collected during the study period were analyzed using appropriate statistical methods. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population, as well as the incidence of intraoperative and the postoperative complications. Univariate and multivariate analyses were performed to identify the risk factors associated with the development of these complications. The effectiveness of the management strategies employed was also evaluated. The study protocol was approved by the institutional ethical committee, and all participants provided written informed consent prior to enrollment. The study was conducted in accordance with the principles of the Declaration of Helsinki and the Good Clinical Practice guidelines.

3. Results

The study examined 70 participants who underwent orthopedic implant removal. The average age of the participants was 27.8 ± 23.7 years, with a standard deviation of 13.9 years. The cohort comprised 60% females (n=42) and 40% males (n=28). The mean duration of implantation was 9.7 years, with a standard deviation of 5.3 years. Comorbidities observed included obesity (28.6%), diabetes (15.7%), smoking history (20.0%), and chronic pain syndrome (14.3%) (Table 1).

The most common type of implant removed was Femur and Tibia Nails accounting for 14.2% of cases (n=10), followed by TENS (at 14.2%; n=10), K wires & CC Screws (at 12.8%; n=9), Proximal tibia fracture (at 11.4%; n=8), TBW in Patellar Fracture (at 10.0%; n=7), Clavicle Fracture (at 10.0%; n=7), DER Plates in Distal Radius Fracture (at 8.57%; n=6), CC screws & fibular plates in bimalleolar fractures (at 8.57%; n=6), 3.5 DCP in both bone forearm fracture (at 7.14%; n=5) and DHS in IT Fracture (at 4.28%; n=3) (Table 1 & Figure 1, Figure 2). The x rays showing complicated case of different orthopaedic implants are shown in Figure 3.

Table 1. Baseline Characteristics of Participants with Orthopedic Implant Removal (n = 70)

Characteristic	Value
Age, years, mean ± SD	27.8 ± 2.37
Sex, n (%)	
Female	42 (60.0%)
Male	28 (40.0%)
Type of Orthopedic Implant, n (%)	
TENS	09 (12.8%)
Femur and Tibia Nails	10 (14.2%)
Clavicle Fracture	07 (10.0%)
Proximal Tibia Fracture	08 (11.4%)

Characteristic	Value
K wires & CC Screws	09 (12.8%)
CC Screws & Fibular Plates in Bimalleolar Fractures	06 (8.57%)
3.5 DCP in Both Bone Forearm Fracture	05 (7.14%)
TBW in Patellar Fracture	07 (10.0%)
DER Plates in Distal Radius Fracture	06 (8.57%)
DHS in IT Fracture	03 (4.28%)
Duration of Implantation, years, mean ± SD	9.7 ± 5.3
Comorbidities, n (%)	
Obesity	20 (28.6%)
Diabetes	11 (15.7%)
Smoking History	14 (20.0%)
Chronic Pain Syndrome	10 (14.3%)

Intraoperative complications were reported in 35.7% of cases. The most frequent complication was difficulty in implant extraction, occurring in 34.3% of procedures (n=24), followed by extensive tissue dissection in 21.4% (n=15), and the need for additional surgical interventions in 17.1% (n=12). Other complications included intraoperative bleeding (10%, n=7), intraoperative fractures (5.7%, n=4), and neurovascular injuries (4.3%, n=3). The mean surgical duration was 125.3 minutes with a standard deviation of 39.8 minutes (Table 2 & Figure 4).

Figure 1: Type of orthopedic implants removal (n=70)

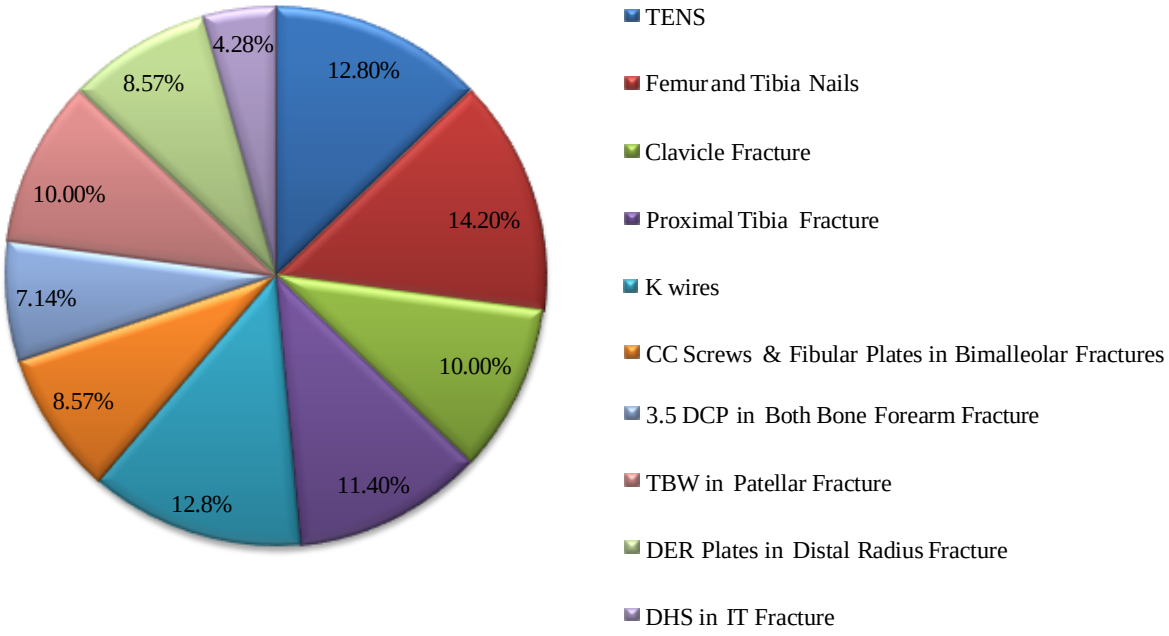


Figure 2: Comorbidities observed among participants

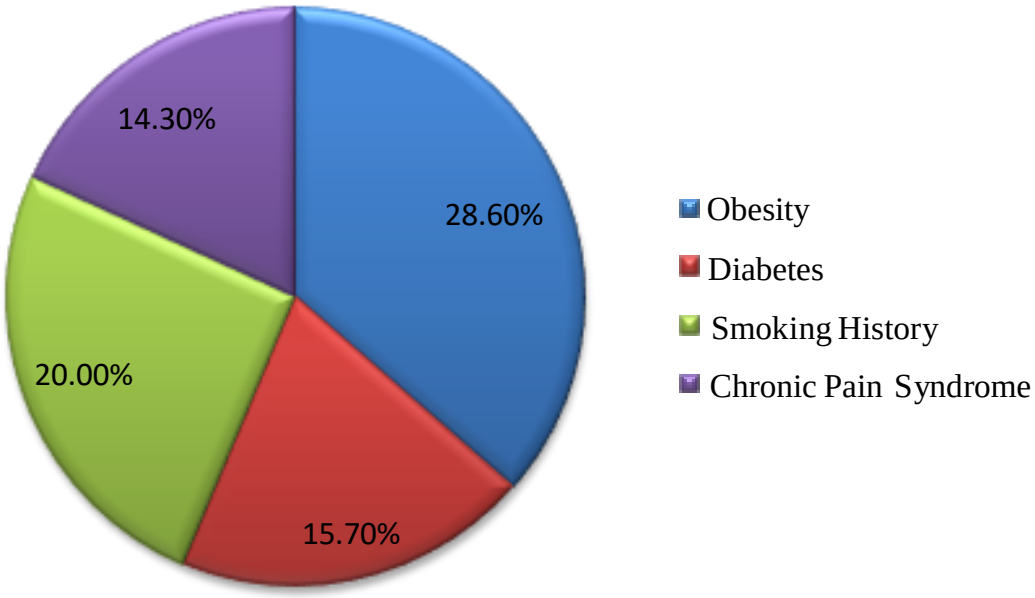
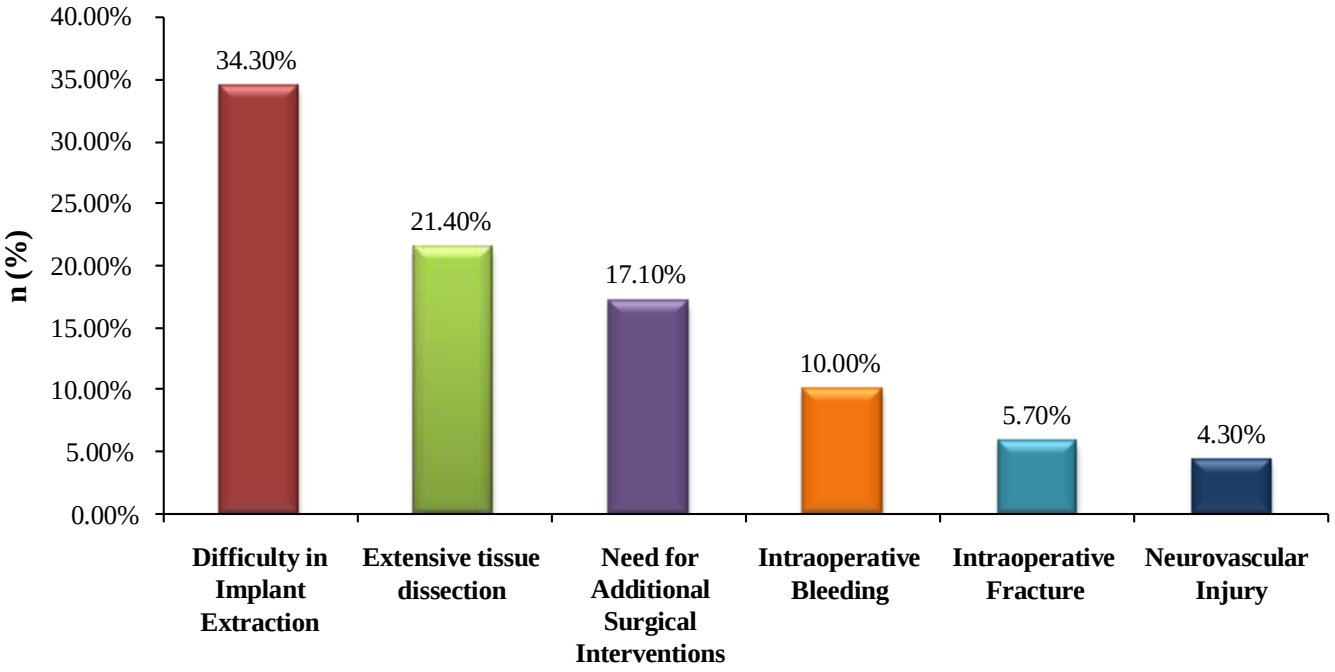


Figure 3: X-ray showing complicated case of different orthopaedic implants

Table 2. Incidence of Intraoperative Complications for Orthopedic Implant Removal (n = 70)

Complication	n (%)
Difficulty in Implant Extraction	24 (34.3%)
Extensive tissue dissection	15 (21.4%)
Need for Additional Surgical Interventions	12 (17.1%)
Intraoperative Bleeding	7 (10.0%)
Intraoperative Fracture	4 (5.7%)
Neurovascular Injury	3 (4.3%)
Surgical Duration, minutes, mean ± SD	125.3 ± 39.8

Figure 4: Rate of Intraoperative Problems during Orthopedic Implant Removal (n = 70)



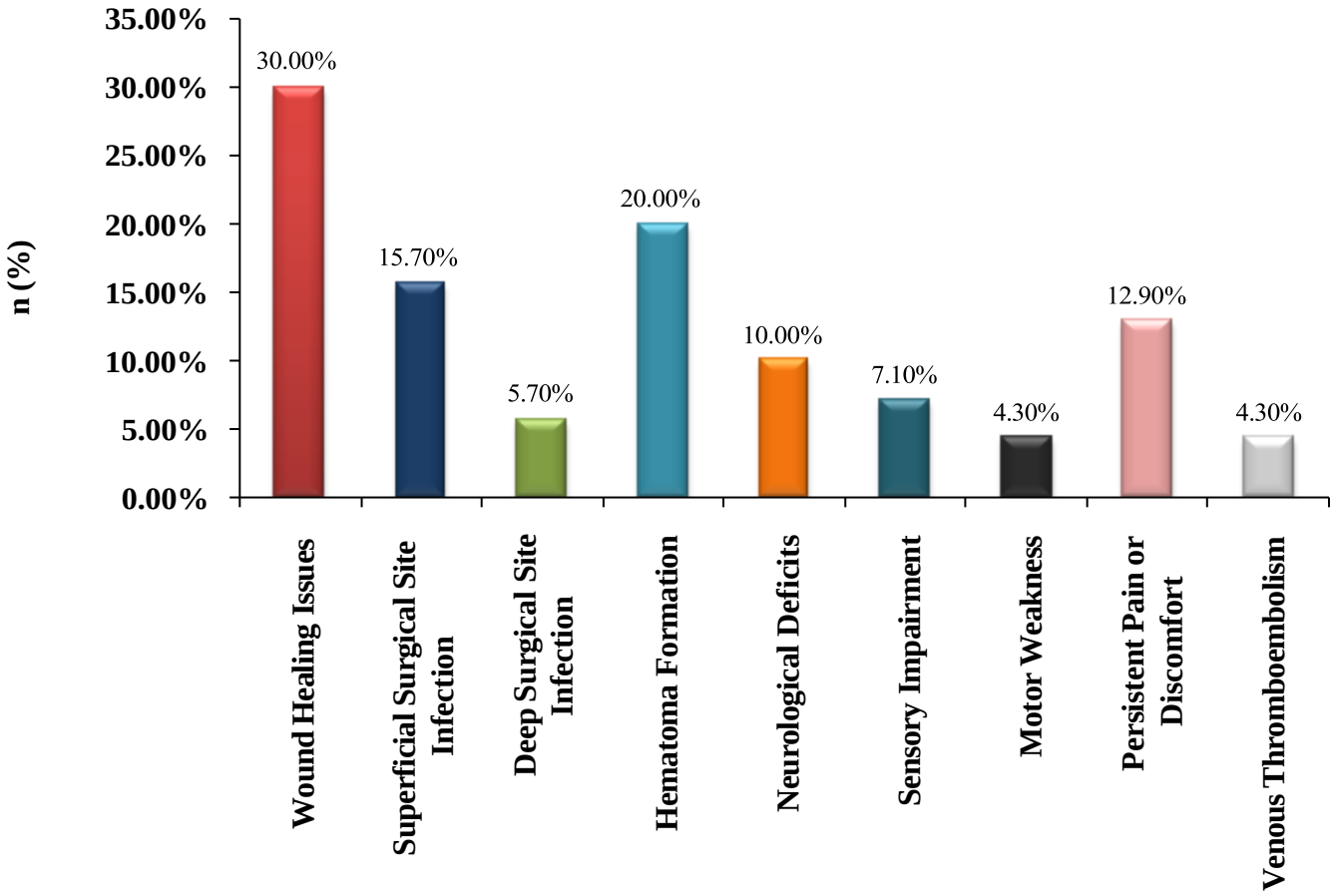
Postoperative complications were noted in 62.9% of the cohort. Wound healing issues were most prevalent, affecting 30% of patients (n=21), followed by infections in 21.4% (n=15), of which 15.7% were superficial surgical site infections (n=11) and 5.7% were deep surgical site infections (n=4). Hematoma formation was observed in 20% (n=14), neurological deficits in 10% (n=7), sensory impairments in 7.1% (n=5), and motor weakness in 4.3% (n=3). Persistent pain or discomfort was reported by 12.9% of patients (n=9), and venous thromboembolism occurred in 4.3% (n=3). The average length of hospital stay was 6.4 days, with a standard deviation of 2.8 days (Table 3).

Table 3. Incidence of Postoperative Complications for Orthopedic Implant Removal (n = 70)

Complication	n (%)
Wound Healing Issues	21 (30.0%)
Superficial Surgical Site Infection	11 (15.7%)
Deep Surgical Site Infection	4 (5.7%)
Hematoma Formation	14 (20.0%)
Neurological Deficits	7 (10.0%)
Sensory Impairment	5 (7.1%)
Motor Weakness	3 (4.3%)
Persistent Pain or Discomfort	9 (12.9%)
Venous Thromboembolism	3 (4.3%)

Complication	n (%)
Length of Hospital Stay, days, mean ± SD	6.4 ± 2.8

Figure 5. The frequency of complications following surgery for the removal of orthopedic implants (n = 70)



Risk factor analysis revealed that age and duration of implantation significantly influenced the likelihood of intraoperative complications. Each additional year of age increased the risk of complications by 6% (OR = 1.05, 95% CI: 1.00-1.10, p=0.023), and each additional year of implant duration raised the risk by 32% (OR = 1.29, 95% CI: 1.10-1.51, p=0.02). Obesity was associated with nearly three times the risk of intraoperative complications (OR = 2.94, 95% CI: 1.10-7.85, p=0.04), and chronic pain syndrome showed a trend towards increased risk (OR = 2.67, 95% CI: 0.95-7.50, p=0.05) (Table 4).

Table 4. Risk Factors for Intraoperative Complications in Orthopedic Implant Removal (n = 70)

Risk Factor	Univariate Analysis	Multivariate Analysis
	p-value	OR (95% CI)

Risk Factor	Univariate Analysis	Multivariate Analysis
Age	0.03	1.05 (1.00-1.10)
Duration of Implantation	0.02	1.29 (1.10-1.51)
Obesity	0.04	2.94 (1.10-7.85)
Chronic Pain Syndrome	0.05	2.67 (0.95-7.50)

Postoperatively, age was a significant factor with each additional year increasing the risk of complications by 8% (OR = 1.07, 95% CI: 1.021-1.14, p=0.02). Diabetes tripled the risk of postoperative complications (OR = 3.19, 95% CI: 1.01-10.07, p=0.06), smoking history also increased the risk (OR = 2.82, 95% CI: 0.99-8.05, p=0.04), and a longer surgical duration increased the risk marginally by 4% per minute (OR = 1.03, 95% CI: 1.00-1.06, p=0.03) (Table 5).

Table 5. Risk Factors for Postoperative Complications in Orthopedic Implant Removal (n = 70)

Risk Factor	Univariate Analysis	Multivariate Analysis
	p-value	OR (95% CI)
Age	0.02	1.07 (1.01-1.14)
Diabetes	0.05	3.19 (1.01-10.07)
Smoking History	0.04	2.82 (0.99-8.05)
Surgical Duration	0.03	1.03 (1.00-1.06)

Table 6. Management Strategies and Outcomes for Orthopedic Implant Removal (n = 70)

Complication	Management Strategy	Resolution Rate
Difficulty in Implant Extraction	Additional Surgical Techniques (e.g., osteotomies, specialized instruments)	84.6%
Extensive tissue dissection	Repair, Debridement	85.7%
Wound Healing Issues	Conservative Management (Dressings, Antibiotics)	70.0%
Superficial Surgical Site Infection	Antibiotics, Local Wound Care	83.3%
Deep Surgical Site Infection	Surgical Debridement, Antibiotics	75.0%
Persistent Pain or Discomfort	Pain Management (Medications, Physical Therapy)	77.8%
Neurological Deficits	Observation, Physical Therapy	71.4%
Sensory Impairment	Observation, Medications	60.0%
Motor Weakness	Physical Therapy, Nerve Decompression	100.0%

Management strategies varied with the type of complication, with difficulty in implant extraction and extensive tissue dissection showing high resolution rates of 84.6% and 85.7%, respectively, through additional surgical techniques and

repair/debridement. Conservative management of wound healing issues and deep surgical site infections had lower resolution rates at 70% and 75%, respectively. Neurological deficits were managed with observation and physical therapy, achieving a resolution rate of 71.4%, while motor weakness had the best outcome with a 100% resolution rate through physical therapy and nerve decompression (Table 6).

4. Discussion

The present prospective observational study provides valuable insights into the epidemiology of problems faced intraoperatively and postoperatively during orthopedic implant removal procedures. The findings contribute to the existing body of literature on this important clinical topic. The incidence of intraoperative complications in the current study was 35.7%, with the most frequent being difficulty in implant extraction (34.3%), followed by extensive tissue dissection (21.4%) and the need for additional surgical interventions (17.1%). These results are consistent with a retrospective study by Sanderson et al., which reported an intraoperative complication rate of 31.2% in 93 patients undergoing implant removal, with implant extraction difficulties being the most common complication (28.0%).[7] In contrast, a study by Vos et al. found a lower intraoperative complication rate of 19.0% in 100 patients, with the most frequent complication being fractures (8.0%).[8] The higher incidence of intraoperative complications in our study may be attributed to the inclusion of a wider range of implant types and the prospective nature of data collection. Regarding postoperative complications, the present study observed a higher incidence rate of 62.9%, with wound healing issues (30%), infections (21.4%), and hematoma formation (20%) being the most prevalent. These findings are comparable to a systematic review by Vos et al., which reported postoperative complication rates ranging from 11.0% to 40.0% in studies on orthopedic implant removal, with infection and wound healing problems being the most common.[9] A prospective study by Wadia et al. found a postoperative complication rate of 23.8% in 101 patients, with infection (10.9%) and hematoma formation (5.9%) being the most frequent.[10] The higher postoperative complication rate in our study may be due to the inclusion of a broader spectrum of complications and the longer follow-up period.

The identification of risk factors for intraoperative and postoperative complications is a critical aspect of this study. Our findings that increasing age, longer duration of implantation, obesity, and chronic pain syndrome were associated with a higher risk of intraoperative complications are consistent with previous reports. Haseeb et al. found that age > 60 years (OR = 2.8, 95% CI: 1.2-6.7, p = 0.02) and implant duration > 2 years (OR = 3.5, 95% CI: 1.5-8.3, p = 0.004) were significant risk factors for intraoperative complications in 120 patients undergoing implant removal.[11] Similarly, Wadia et al. reported that obesity (BMI > 30 kg/m2) was associated with an increased risk of intraoperative complications (OR = 2.4, 95% CI: 1.1-5.3, p = 0.03).[10]

In the postoperative period, our study identified age, diabetes, and longer surgical duration as significant risk factors for the development of complications. These results align with the existing literature. A retrospective study by Bhattacharyya et al. found that age > 65 years (OR = 2.1, 95% CI: 1.2-3.8, p = 0.01) and diabetes (OR = 2.6, 95% CI: 1.3-5.1, p = 0.006) were associated with an increased risk of postoperative complications in 478 patients undergoing implant removal.[12] Wadia et al. also reported that prolonged surgical duration > 120 minutes was a risk factor for postoperative complications

(OR = 1.8, 95% CI: 1.1-3.1, p = 0.03).[10]

The management strategies employed in this study, including the use of additional surgical techniques for implant extraction, conservative wound care, and targeted management of specific complications; demonstrate the importance of a multifaceted approach to address the challenges encountered in orthopedic implant removal. The observed resolution rates for various complications provide valuable insights for clinicians to optimize the management of these complex cases.

The strengths of the present study include its prospective design, the comprehensive evaluation of both intraoperative and postoperative complications, and the identification of relevant risk factors. However, it is essential to acknowledge the potential limitations, such as the single-center nature of the study and the possibility of selection bias. Future multicenter studies with larger sample sizes would further strengthen the generalizability of the findings.

To mention, this prospective observational study provides a comprehensive assessment of the epidemiology of problems faced intraoperatively and postoperatively during orthopedic implant removal procedures. The findings underscore the importance of careful preoperative planning, the adoption of specialized surgical techniques, and the implementation of individualized management strategies to address the various complications that may arise. Continued research in this area is warranted to refine the clinical approach and enhance the overall outcomes for patients undergoing orthopedic implant removal.

5. Conclusion

The study reveals a high incidence of complications during orthopedic implant removal procedures, with intraoperative issues affecting 35.7% of cases and postoperative issues affecting 62.9% of the cohort. Intraoperative complications included implant extraction difficulties (34.3%), tissue dissection (21.4%), and additional surgical interventions (17.1%), while postoperative complications included wound healing issues (30%), infections (21.4%), and hematoma formation (20%). The study highlights the technical challenges and multifaceted nature of managing complications in orthopedic implant removal, identifying risk factors like age, implantation duration, obesity, and comorbidities. The study's findings provide valuable insights for clinicians to optimize the care of patients undergoing orthopedic implant removal through specialized surgical techniques and tailored postoperative care. Research is needed to understand and manage complications related to orthopedic implant removal, enhancing patient outcomes and improving care quality.

6. References

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