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ORIGINAL ARTICLE

Impact of Bariatric Surgery on Intervertebral Disc Pathology and Low Back Pain

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Background: Obesity is a growing global health concern associated with a range of comorbidities, including chronic low back pain (LBP) and intervertebral disc (IVD) degeneration. Bariatric surgery (BS) is a well-established intervention for significant weight reduction; however, its impact on spinal health, particularly LBP and disc pathology, remains inconclusive. This study aimed to assess the effects of bariatric surgery on intervertebral disc height and chronic low back pain using both imaging and clinical outcome measures.

Methods: This retrospective pre–post observational study analysed 31 obese patients (BMI ≥ 30 kg/m²) with chronic LBP who underwent bariatric surgery at a single tertiary hospital. Clinical outcomes, including BMI, Visual Analogue Scale (VAS) for pain, Disability Rating Index (DRI), and Roland-Morris Disability Questionnaire (RMD), were assessed before surgery and postoperatively after a minimum follow-up of 3 months. MRI scans were evaluated using the modified Pfirrmann grading system to assess disc degeneration. Statistical analyses included paired t-tests and Wilcoxon signed-rank tests.

Results: The study cohort had a mean age of 42.8 years, with 87% of participants being female. Postoperative BMI was significantly reduced ($p < 0.001$), confirming effective weight loss. However, there were no statistically significant improvements in VAS, DRI, or RMD scores nor in Pfirrmann grades at any lumbar level ($p > 0.05$). A significant association was found between older age (>40 years) and higher postoperative RMD scores ($p=0.010$).

Conclusion: While bariatric surgery effectively reduces BMI, it does not appear to confer statistically significant short- to mid-term benefits for LBP or IVD degeneration. These findings suggest that weight loss alone may be insufficient to address spinal pathology and highlight the need for integrated, multimodal management strategies. Further long-term prospective studies are needed to evaluate the potential delayed effects of weight reduction on spinal health.

Keywords: Bariatric surgery, low back pain, intervertebral disc degeneration, obesity, MRI, Pfirrmann grading, spinal health

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Introduction

Obesity is a preventable, multifactorial disease that poses a wide range of health risks to patients and has become a global health burden due to its rising prevalence. Body mass index (BMI) – a calculation of an individual's body weight relative to their height – is typically used to classify different levels of obesity. These categories are overweight (25.0–29.9 kg/m²); obesity Class 1 (30.0–34.9 kg/m²); Class 2 (35.0–39.9 kg/m²); and Class 3, also known as morbid obesity (>40.0 kg/m²).^{1,2} In 2021, the six leading contributors to disability-adjusted life years (DALYs) due to high BMI were diabetes mellitus, ischemic heart disease, hypertensive heart disease, chronic kidney disease, lower back pain, and stroke, among other health issues³. It is estimated that 40% of the world's adult

population will be overweight, while 20% will be considered obese by 2030⁴. As of 2024, the obesity rate in Bahrain has escalated to 41%⁵. Additionally, a surge in intervertebral disc degeneration and lower back pain has been recorded, affecting around one-third of obese individuals and adding to the considerable strain on the public health system⁶.

Lower back pain (LBP) is acknowledged as a serious concern among obese patients, with weight loss frequently recommended as a primary treatment despite a lack of robust research supporting its therapeutic effectiveness. This recommendation stems from the association of obesity with lower back pain due to its role in increasing axial load on the spine and adipose-derived inflammation^{4,7}. Central obesity, in particular, shifts the body's centre of gravity, resulting in

excessive mechanical stress on the intervertebral discs and facets, which diminishes disc space and heightens lumbar lordosis. Furthermore, the metabolic activity in adipose tissue is known to elevate pro-inflammatory factors such as TNF- α , IL-6, and CRP, which further exacerbate disc degeneration and chronic inflammation^{7,8}. Moreover, obese patients with vertebral conditions necessitating spinal surgery tend to benefit less than those with a lower BMI and are at higher risk for complications including infections and venous thromboembolism⁹.

Given the multifactorial link between obesity and low back pain, weight reduction has emerged as a feasible treatment strategy in the comprehensive management of obese patients with spinal pathology, particularly via bariatric surgery (BS). Over the last few decades, the rise of bariatric surgical procedures has significantly contributed to weight reduction and alleviation of related comorbidities, especially when conservative weight loss methods have proven ineffective¹⁰. The dramatic weight loss post-surgery results in axial offloading and reduces inflammation, theoretically facilitating improvements in disc compression, degeneration, and pain. Nevertheless, bariatric surgery is not without its complications. In regards to spinal health, BS has been linked to a notable decrease in bone mineral density and increased risk of fracture, as well as spinal diagnoses, including stenosis, disc herniation, and spondylolisthesis^{11,12}. These effects tend to be more pronounced in post-menopausal women, a population with the highest prevalence of both obesity and low back pain¹³. These conflicting findings contribute to ongoing controversy regarding the appropriateness of BS for treating intervertebral pathology in obese individuals. Multiple studies have indeed shown a decrease in lower back pain, inflammatory cytokines, and quality of life following bariatric surgery^{7,10}. Nevertheless, other studies displayed negligible findings, and there remains a lack of definitive data on intervertebral disc height changes following significant weight reduction⁶.

Magnetic resonance imaging (MRI) is a widely used technique for assessing intervertebral disc degeneration. Pfirrmann et al¹⁴, devised a grading system for disc degeneration based on aspects such as MR signal intensity, disc structure, the distinction between nucleus and annulus, and disc height. The primary aim of this study is to observe the impact of substantial weight reduction achieved post-bariatric surgery on intervertebral disc height and its effects on low back pain in obese individuals. These parameters will be investigated by comparing MRI findings using the Pfirrmann grading scale and assessing pain/disability by the Visual Analog Scale (VAS), Disability Rating Index (DRI), and the Roland-Morris Disability Questionnaire (RMD).

Methods

Study Protocol

A total of 31 patients suffering from chronic low back pain who were undergoing bariatric surgery from 2016 to 2020 at a single university hospital from the Orthopaedic Surgery, General Surgery, and Radiology Departments were retrospectively enrolled and analysed in this retrospective pre-post observational study, following meeting the set inclusion and exclusion criteria. A convenience sampling technique was implemented, where all male and female patients aged 20 to 80 years who meet the inclusion and exclusion criteria were enrolled. A total of 31 patients were enrolled, including 4 males and 27 females, resulting in a predominantly female cohort. Data were collected from the radiology and the HOPE health record system at the hospital, supplemented by communication with patients and their families. The collected data was then used to investigate the impacts of post-bariatric weight reduction on intervertebral disc height and its effects on low back pain in the enrolled participants. Ethical approval was received by the overseeing research ethics committee. Patients were included if they were obese (defined as a BMI ≥ 30 kg/m²), aged between 20 to 80 years, and had undergone a bariatric surgical procedure (Laparoscopic Sleeve Gastrectomy, Laparoscopic Roux-en-Y Gastric Bypass, Mini Gastric Bypass). Moreover, patients must have presented with episodes of low back pain greater than four weeks in duration and had at least 1-year follow-up for low back aches. Lastly, patients were required to have a preoperative MRI and a postoperative MRI obtained at least 3 months after bariatric surgery. The mean postoperative follow-up duration was 24 ± 18 months, with a range of 3 to 73 months. Exclusion criteria included prior lumbar spine surgery, psychological disorders, suspected secondary gain related to MRI utilization, prescription narcotic dependence, and referred pain of visceral or somatic origin. These exclusions were applied to reduce potential confounding from factors that could independently affect pain perception, functional disability scores, symptom reporting, or the attribution of symptoms to lumbar disc pathology.

Data Collection

The data collected from patients included clinical information regarding their bariatric surgery, MRI imaging findings, and orthopaedic visits were taken from the HOPE online database system utilized by the hospital. Additionally, participants' responses to the Visual Analog Scale for Pain (VAS Pain) were collected, where the VAS Pain scale is a unidimensional measure of pain intensity, widely used in diverse adult populations to categorize the level of pain that a patient experiences. Additionally, clinical outcomes were evaluated using the Roland Morris Disability (RMD) Questionnaire and the Disability Rating Index (DRI). Lastly, MRI findings, including intervertebral disc changes and intervertebral height, were assessed using a modified Pfirrmann grading system based on routine radiological interpretation by multiple radiologists. Because of the retrospective nature of the study, formal blinded reassessment of the scans was not performed.

Statistical Analysis

All collected participants' data was anonymized and tabulated using spreadsheets. Standard descriptive statistics, including means and standard errors, were used to summarize the continuous measures and frequencies and percentages for the categorical measures for posterior stabilized and cruciate retaining groups. Statistical data were analysed using Statistical Packages for Social Sciences (SPSS) version 26 Armonk, NY: IBM Corporation. Categorical variables were shown as numbers and percentages, while continuous variables were presented as mean and standard deviation. A Paired t-test was conducted to determine the differences between BMI, VAS, DR, and RMD before and after bariatric surgery. Differences in Pfirrmann grade before and after surgery were analysed using the Wilcoxon signed-rank test. Given the exploratory nature of this retrospective study, no formal adjustment for multiple comparisons was performed; therefore, the results should be interpreted with appropriate caution. In addition, the Fischer Exact test was used to determine the association between patients' characteristics and age group. A P-value <0.05 was considered statistically significant.

Results

This study reviewed 31 patients before and after undergoing bariatric surgery and investigated the relevant changes in BMI, intervertebral disc, and height changes, as well as relevant VAS, DRI, RMD, and Pfirrmann MRI staging scores. Table 1 shows patients' mean age was 42.8 years (SD 10.6), with participants over 40 years old being dominant in the study (61.3%). Also, the majority of the patients in the study were female (87.1%). The mean postoperative follow-up duration was 24 ± 18 months (range: 3–73 months).

Table 1: Demographic characteristics of the patients (n=31)

Study variables	N (%)
Age in years (mean ± SD)	42.8 ± 10.6
≤40 years	12 (38.7%)
>40 years	19 (61.3%)
Gender	
Male	04 (12.9%)
Female	27 (87.1%)

In Table 2, the paired t-test indicates that the BMI levels after surgery were statistically significantly lower than before surgery ($p < 0.001$) (see also Figure 1). No significant differences were observed between VAS, DRI, and RMD before and after bariatric surgery ($p > 0.05$).

Table 2: Paired t-test of BMI, VAS DRI, and RMD before and after bariatric surgery (n=31)

Factor	Pre-Surgery Mean ± SD	Post-Surgery Mean ± SD	P-value §
BMI in kg/m ²	39.8 ± 7.89	31.2 ± 7.01	<0.001 **
VAS	6.52 ± 2.74	5.52 ± 2.26	0.127
DRI	770.9 ± 273.5	680.6 ± 355.4	0.178
RMD	7.32 ± 5.24	6.77 ± 5.38	0.630

§ P-value has been calculated using paired sample t-test.

** Significant at $p < 0.05$ level.

In Figure 1 below, a comparison of BMI value in kg/m² can be seen as measured before bariatric surgery and after surgery, where a significant reduction in BMI can be seen post-surgery ($p < 0.001$).

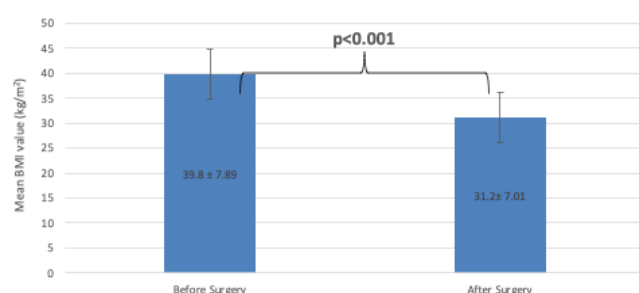


Figure 1: Comparison of BMI preoperatively and postoperatively after bariatric surgery.

Comparison of pre- and postoperative Pfirrmann grades at L1–L2, L2–L3, L3–L4, L4–L5, and L5–S1 using the Wilcoxon signed-rank test showed no statistically significant differences (all $p > 0.05$).

Table 3: Comparison of Pfirrmann grading before and after bariatric surgery using the Wilcoxon signed-rank test (n=31)

Factor	Pre-Surgery N (%)	Post-Surgery N (%)	P-value §
Pfirrmann L1-L2			

Stage 1	15 (48.4%)	12 (38.7%)	0.763
Stage 2	07 (22.6%)	13 (41.9%)	0.763
Stage 3	06 (19.4%)	04 (12.9%)	0.763
Stage 4	02 (06.5%)	01 (03.2%)	0.763
Stage 5	01 (03.2%)	01 (03.2%)	0.763
Pfirrmann L2-L3			
Stage 1	09 (29.0%)	08 (25.8%)	0.467
Stage 2	08 (25.8%)	12 (38.7%)	0.467
Stage 3	07 (22.6%)	05 (09.7%)	0.467
Stage 4	04 (12.9%)	03 (09.7%)	0.467
Stage 5	03 (09.7%)	03 (09.7%)	0.467
Pfirrmann L3-L4			
Stage 1	08 (25.8%)	05 (16.1%)	0.166
Stage 2	06 (19.4%)	09 (29.0%)	0.166
Stage 3	12 (38.7%)	10 (32.3%)	0.166
Stage 4	03 (09.7%)	05 (16.1%)	0.166
Stage 5	02 (06.5%)	02 (06.5%)	0.166
Pfirrmann L4-L5			
Stage 1	04 (12.9%)	01 (03.2%)	0.808
Stage 2	08 (25.8%)	12 (38.7%)	0.808
Stage 3	09 (29.0%)	08 (25.8%)	0.808
Stage 4	06 (19.4%)	07 (22.6%)	0.808
Stage 5	04 (12.9%)	03 (09.7%)	0.808
Pfirrmann L5-S1			
Stage 1	05 (16.1%)	05 (16.1%)	0.317
Stage 2	09 (29.0%)	08 (25.8%)	0.317
Stage 3	04 (12.9%)	09 (29.0%)	0.317
Stage 4	10 (32.3%)	07 (22.6%)	0.317
Stage 5	03 (09.7%)	02 (06.5%)	0.317

§ P-value has been calculated using the Wilcoxon signed rank test.

When comparing the age group and the postoperative characteristics of the patients (Table 4), it was found that the mean value of RMD was statistically significantly higher

among the older age group ($p=0.010$) (see also Figure 2). No significant differences were observed between the age group and the rest of the postoperative characteristics, including BMI, VAS, DRI, and all Pfirrmann stages ($p>0.05$).

Table 4: Postoperative characteristics of the patients according to age group (n=31)

Factor	Age ≤40 years N (%) (n=12)	Age >40 years N (%) (n=19)	P-value §
BMI in kg/m ² (mean ± SD)	31.2 ± 9.00	31.2 ± 5.68	0.981 ‡
VAS (mean ± SD)	5.08 ± 2.57	5.79 ± 2.07	0.407 ‡
DRI (mean ± SD)	650.0 ± 389.6	700.0 ± 341.6	0.710 ‡
RMD (mean ± SD)	3.75 ± 5.03	8.68 ± 4.77	0.010 ** ‡
Pfirrmann L1-L2			
Stage 1-2	10 (83.3%)	15 (78.9%)	1.000

Pfirrmann L2-L3			
Stage 1-2	08 (66.7%)	12 (63.2%)	1.000
Stage 3-5	04 (33.3%)	07 (36.8%)	1.000
Pfirrmann L3-L4			
Stage 1-2	06 (50.0%)	08 (42.1%)	0.724
Stage 3-5	06 (50.0%)	11 (57.9%)	0.724
Pfirrmann L4-L5			
Stage 1-2	06 (50.0%)	07 (36.8%)	0.710
Stage 3-5	06 (50.0%)	12 (63.2%)	0.710
Pfirrmann L5-S1			
Stage 1-2	06 (50.0%)	07 (36.8%)	0.710
Stage 3-5	06 (50.0%)	12 (63.2%)	0.710

§ P-value has been calculated using the Fischer Exact test.

† P-value has been calculated using an independent sample t-test.

** Significant at $p < 0.05$ level.

In an exploratory age-stratified analysis, postoperative RMD scores were higher among patients aged >40 years compared with those aged ≤ 40 years (Figure 2; $p = 0.010$).

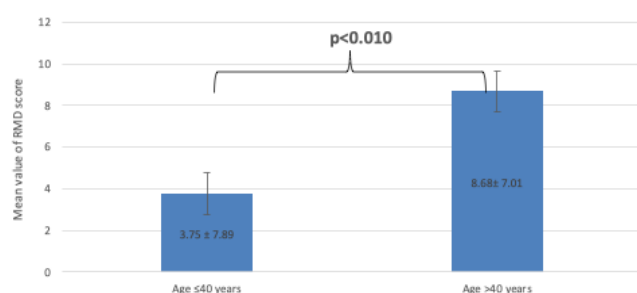


Figure 2: Comparison of Roland-Morris Disability (RMD) mean value according to age group postoperatively.

Discussion

In analysing the demographic and clinical characteristics of our 31-patient cohort, the mean age of patients was 42.8 years, with most participants being above the age of 40 (61.3%), and a predominant female majority of 87.1% of the patients. The female majority of participants with LBP aligns with the growing literature indicating a higher prevalence of LBP in women compared to men¹⁵. There was a statistically significant BMI reduction post-bariatric surgery ($p < 0.001$) with no statistically significant improvements in LBP before and after bariatric surgery as expressed through the VAS, DRI, and RMD scores ($p > 0.05$), as well as no significant change in disc degeneration as portrayed by the Pfirrmann stages ($p > 0.05$). From a clinical perspective, the mean change in VAS was 1.0 point (6.52 to 5.52), and the mean change in RMD was 0.55 points (7.32 to 6.77), both of which fall below commonly cited thresholds for minimal clinically important change in low back pain outcomes. This suggests that, in addition to being statistically non-significant, the average postoperative changes were also unlikely to represent clinically meaningful improvement at the group level. An exploratory age-stratified

analysis showed higher postoperative RMD scores among patients older than 40 years ($p = 0.010$). However, given the small sample size, additional subgroup comparisons, and lack of adjustment for multiple testing, this observation should be interpreted cautiously and considered hypothesis-generating. While bariatric surgery is well-established for its metabolic and cardiovascular benefits, its impact on musculoskeletal disorders, particularly low back pain (LBP) and intervertebral disc (IVD) degeneration, remains less definitive. Our findings with regard to no statistically significant improvement in LBP despite BMI reduction echo previous studies in the literature, which demonstrate that reductions in BMI do not consistently translate into proportional improvements in LBP. Lee et al.¹⁶, using data from the Korean National Health and Nutrition Examination Survey, reported no significant relationship between weight change and chronic LBP in individuals over 50 years of age, even in those with a ≥ 6 kg weight reduction. Similarly, a meta-regression analysis including five studies found no statistically significant correlation between BMI reduction and pain score improvement or decrease in pain score ($r = 0.034$, $p = 0.19$).⁶ Lidar et al.¹⁷ also failed to identify a significant relationship between decreased BMI and back pain improvement ($r = 0.231$, $p = 0.218$), highlighting the complexity of LBP pathophysiology and suggesting that weight loss alone may be insufficient in alleviating symptoms.

Conversely, some prospective studies demonstrate a positive correlation between post-bariatric weight loss and reductions in LBP severity. Lidar et al.¹⁷ reported that a 37 kg average weight loss over 12 months was associated with a significant reduction in axial and radicular LBP. Vincent et al.¹⁸ and Khoeir et al.¹⁹ similarly observed substantial reductions in LBP severity by 54% and 44% respectively and improvements in quality-of-life post-bariatric surgery. These discrepancies may be attributed to variations in study design, sample characteristics, follow-up duration, and whether disc degeneration had already progressed beyond reversibility at the time of intervention. Moreover, mechanical offloading via

weight loss may not be enough to reverse structural disc pathology once it has advanced. Nevertheless, as Johnston et al.²⁰ noted, even modest weight loss can yield clinically significant improvements in symptoms, but the absence of direct correlation with BMI change suggests other mechanisms, possibly inflammatory or neuroplastic, may mediate pain perception.

One explanation for the limited symptom relief in some patients is the persistence of chronic structural changes. Samartzis et al.²¹ emphasized that advanced disc degeneration, characterized by disc space narrowing, osteophytic changes, and spinal canal stenosis, is unlikely to be reversible through mechanical unloading through weight loss alone. Moreover, obesity may exert its effects not only through mechanical loading but also through systemic inflammatory responses mediated by adipocytokines (e.g., leptin, tumour necrosis factor- α [TNF- α], Interleukin-6 [IL-6]) and vascular insufficiency to the vertebrae, through atherosclerosis and high serum lipids, contributing to disc hypoxia and degeneration²¹. Age-related alterations in supraspinal pain processing may also explain variability in patient outcomes. Older adults may experience enhanced or diminished pain perception due to neurodegenerative changes affecting pain modulation pathways, including the insular cortex, striatum, and prefrontal cortex.²² This could mask or amplify reported LBP despite anatomical improvements post-surgery, complicating the interpretation of subjective pain outcomes²². Methodological limitations in our study may have further contributed to these results. The relatively short postoperative follow-up period may have been insufficient to capture the full extent of disc rehydration or remodelling. Additionally, the small cohort sample size, predominance of female participants (87%), and absence of a non-surgical control group limit the generalizability and inferential strength of our findings. In particular, the female predominance may reduce generalizability to male patients and more sex-balanced bariatric populations.

Our study highlights that while bariatric surgery may facilitate significant weight loss and potential mechanical offloading, it should not be considered a standalone solution for managing LBP or IVD pathology. Multimodal management strategies, including physiotherapy, targeted trunk muscle activation, and patient education, remain essential for optimizing outcomes. The 2021 JOSPT clinical practice guidelines emphasize exercise interventions tailored to pain location and chronicity, including core strengthening, movement control, and multimodal approaches, particularly in older adults and those with chronic or postoperative pain²³. Additionally, clinicians must counsel patients that while weight loss improves cardiovascular and metabolic health, its impact on spinal symptoms may be delayed or limited by irreversible disc pathology, central sensitization, or altered pain processing²⁴.

Despite the absence of statistically significant changes in Pfirrmann grades at any lumbar level after bariatric surgery (all $p > 0.05$), some non-significant directional changes were observed on MRI; however, these should not be interpreted as evidence of definite disc improvement. At the L2-L3 level, the number of patients with Grade 2 degeneration increased from 8 (25.8%) preoperatively to 12 (38.7%) postoperatively. A similar pattern was observed at L3-L4, with Grade 2 cases increasing from 6 (19.4%) to 9 (29.0%), and at L4-L5, from 8 (25.8%) to 12 (38.7%). These shifts, although not reaching statistical significance, suggest mild regression in degenerative changes in some mid-lumbar discs, possibly reflecting early biomechanical unloading following significant weight loss, and potential rehydration in mid-lumbar segments, which are less burdened than the lower L5-S1 segment. Conversely, the lower lumbar segments, particularly L5-S1, showed minimal change, with the majority of patients remaining in Grades 3 to 5, consistent with irreversible degeneration due to sustained axial load over time. Notably, 11 out of 31 patients (35.5%) demonstrated improvement by at least one Pfirrmann grade at one or more lumbar levels. While not statistically significant, these isolated disc-level improvements underscore the heterogeneity in disc response to weight loss and suggest early signs of remodelling may occur in less severely degenerated discs and may be possible even within a short follow-up period of 3 to 12 months.

The notion that weight gain or obesity places an increased axial load on the mid-lumbar has been demonstrated in previous studies, where a study by Urquhart et al.²³ specifically examined the relationship between obesity and intervertebral disc height across different lumbar levels. They found that obesity was associated with reduced disc height at the L1-L2 and L3-L4 levels. However, no significant relationship was observed at the lumbosacral junction (L5-S1), consistent with our study's findings²³. This suggests that the impact of obesity on disc height may vary along the lumbar spine, potentially due to differences in biomechanical loading or susceptibility to degeneration at different levels²³. Lidar et al.'s¹⁷ study further supports this claim, where they found that reduction in body weight after bariatric surgery in morbidly obese patients was associated with a significant radiographical increase in the L4-L5 disc space height as well as a significant clinical improvement in axial back and radicular leg pain one-year post-surgery, suggesting that substantial weight loss can lead to radiographic improvements in disc morphology.

Obesity contributes to intervertebral disc degeneration not only through increased axial loading but also via metabolic and inflammatory mechanisms, where adipose tissue secretes pro-inflammatory cytokines such as TNF- α , IL-6, and leptin²⁵. These mediators accelerate matrix breakdown and disrupt disc cell homeostasis, contributing to higher Pfirrmann grades and disc height loss²⁵. Weight loss, particularly through bariatric

surgery, can reduce these inflammatory signals and mechanical stresses, potentially restoring glycosaminoglycan content, improving disc hydration, and stabilizing the micro-nano environment of the intervertebral disc²⁶. Additionally, improved vascular supply and nutrient diffusion associated with weight loss may promote disc regeneration and preservation of extracellular matrix components like collagen and proteoglycans, both of which are closely linked to Pfirrmann grade progression²⁷. While longitudinal studies directly showing improvements in Pfirrmann grading post-weight loss are sparse, the correlation between high BMI and increased disc degeneration severity, as seen in the Mexican cohort study, supports a mechanistic link and the potential for radiological improvement following sustained weight reduction²⁷.

Given that disc degeneration is a chronic process, the relatively short time window in our study may have been insufficient to capture the full potential for disc remodeling post-surgery. Furthermore, the disconnect between radiological findings and patient-reported clinical outcomes (VAS, DRI, RMD), supports the complexity of LBP pathophysiology and supports the notion that Pfirrmann grading alone may not fully capture symptomatology or functional impact. These findings have direct implications for clinical practice and patient education within King Hamad University Hospital (KHUH) and the broader Bahraini healthcare system. Given the high prevalence of obesity and increasing demand for bariatric surgery, our results underscore the need for integrated care models that include postoperative physiotherapy and pain management services. Educating patients on realistic expectations, post-surgery is crucial for informed decision-making and long-term adherence to rehabilitation programs. Incorporating spine-specific assessments and preoperative counselling into bariatric protocols may enhance outcomes and reduce the burden of chronic musculoskeletal complaints on the healthcare system.

Future studies should involve larger, multicentre cohorts with stratification by age, sex, and baseline disc degeneration. Prospective longitudinal studies with extended follow-up, ranging from two and up to five years, are also essential to evaluate the durability of post-surgical improvements and potential disc regeneration. Incorporating advanced MRI techniques such as T2 mapping or quantitative water content analysis could provide more sensitive assessments of early disc recovery. Additionally, age-based stratification in future work may help clarify whether younger patients, who may have more regenerative potential, are more likely to benefit radiologically from weight reduction. Although some individual patients may have experienced symptomatic benefit, the present analysis was based on aggregate pre- and postoperative summary measures, and the proportion of patients achieving clinically meaningful improvement was not specifically analysed. Future studies should incorporate responder analyses based on predefined minimal clinically

important difference (MCID) thresholds. Lastly, investigating the efficacy of combining bariatric surgery with other modalities of treatment, such as structured rehabilitation programs, may also help optimize spinal outcomes.

Limitations

This study is constrained by its single-centre retrospective design, modest sample size, and potential selection bias. The relatively small cohort may have limited the statistical power to detect small to moderate but clinically meaningful changes in pain scores and Pfirrmann grading, increasing the risk of type II error. This concern is particularly relevant given the multiple comparisons performed across lumbar levels. In addition, multiple clinical outcomes and lumbar-level comparisons were assessed without formal correction for multiple testing, which increases the risk of type I error. Accordingly, statistically significant associations should be interpreted cautiously and considered exploratory. In addition, Pfirrmann grading was based on routine radiological assessment in a retrospective setting, and formal blinded reassessment of the scans was not performed, which may have introduced observer-related bias. Moreover, postoperative physical activity levels and participation in rehabilitation or physiotherapy were not measured or adjusted for, which may have influenced pain and functional outcomes independently of bariatric surgery itself. The lack of long-term imaging follow-up precludes assessment of delayed regenerative changes in the IVD. Furthermore, the absence of a matched non-bariatric control group limits our ability to discern whether observed trends were surgery-specific or simply reflective of natural disease progression, undermining the potential long-term effects that bariatric surgery may offer with regards to delaying the progression of LBP and IVD degenerative pathologies.

Conclusion

This study demonstrated that although bariatric surgery resulted in significant weight loss among obese patients, it did not yield statistically significant improvements in low back pain scores or intervertebral disc degeneration within the observed follow-up period. Although Pfirrmann grade changes were not statistically significant, 11 of 31 patients (35.5%) showed improvement at one or more lumbar levels, but overall, no statistically significant radiological improvement was observed during the follow-up period. These findings suggest that the relationship between obesity, spinal pathology, and symptom relief is multifactorial and may not be solely attributable to mechanical offloading. Given the complex pathophysiology of chronic low back pain, including potential irreversible disc changes and altered pain processing, bariatric surgery should be considered part of a comprehensive treatment plan rather than a stand-alone intervention. Future large-scale, prospective studies with longer follow-up durations and combined therapeutic strategies are warranted to fully elucidate the role of weight loss in spinal health and patient-reported outcomes.

Abbreviations

BMI: Body Mass Index

LBP: Low Back Pain

IVD: Intervertebral Disc

BS: Bariatric Surgery

MRI: Magnetic Resonance Imaging

VAS: Visual Analog Scale

DRI: Disability Rating Index

RMD: Roland Morris Disability Questionnaire

TNF- α : Tumor Necrosis Factor-alpha

IL-6: Interleukin-6

CRP: C-Reactive Protein

DALYs: Disability-Adjusted Life Years

MR: Magnetic Resonance

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Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethical approval was received by the Royal Medical Services research ethics committee, providing the ethical approval for conducting research at KHUH (IRB-20-335). All participants provided informed consent prior to their involvement in the study.

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References

- Kelly T, Yang W, Chen CS, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. *Int J Obes*. 2008 Sep;32(9):1431–7. doi:10.1038/ijo.2008.102 PubMed PMID: 18607383.
- Obesity and overweight [Internet]. [cited 2026 May 16]. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
- Zhou XD, Chen QF, Yang W, Zuluaga M, Targher G, Byrne CD, et al. Burden of disease attributable to high body mass index: an analysis of data from the Global Burden of Disease Study 2021. *EclinicalMedicine*. 2024 Oct;76:102848. doi:10.1016/j.eclinm.2024.102848 PubMed PMID: 39386160; PubMed Central PMCID: PMC11462227.
- Joaquim AF, Helvie P, Patel AA. Bariatric Surgery and Low Back Pain: A Systematic Literature Review. *Global Spine Journal*. 2020 Feb 1;10(1):102–10. doi:10.1177/2192568219826935
- Barakat O, Babili M, AlFaraj N, Almusalam R, Swartz S, Al-Hussain BN, et al. Bodyweight and obesity perceptions among adults in Bahrain. *East Mediterr Health J*. 2024 Apr 14;30(3):196–203. doi:10.26719/emhj.24.008 PubMed PMID: 39584434.
- Koremans FW, Chen X, Das A, Diwan AD. Changes in Back Pain Scores after Bariatric Surgery in Obese Patients: A Systematic Review and Meta-Analysis. *J Clin Med*. 2021 Apr 1;10(7):1443. doi:10.3390/jcm10071443 PubMed PMID: 33916220; PubMed Central PMCID: PMC8036450.
- Roffey D, Budiansky A, Coyle M, Wai E. Obesity and Low Back Pain: Is There a Weight of Evidence to Support a Positive Relationship? *Current Obesity Reports*. 2013 Sep 1;2. doi:10.1007/s13679-013-0058-7
- Özdemir FE, Şeşen H, Demirkale İ, Öztürk D, Buluş H, Altay M. Does extreme weight loss after bariatric surgery alter spinopelvic parameters and ameliorate back pain? A retrospective case study. *Jt Dis Relat Surg*. 2024 Jul 8;35(3):603–9. doi:10.52312/jdrs.2024.1683 PubMed PMID: 39189570; PubMed Central PMCID: PMC11411890.
- Delgado-López PD, Castilla-Diez JM. [Impact of obesity in the pathophysiology of degenerative disk disease and in the morbidity and outcome of lumbar spine surgery]. *Neurocirugia (Engl Ed)*. 2018;29(2):93–102. doi:10.1016/j.neucir.2017.06.002 PubMed PMID: 28750870.
- Ergin A, Ergin E, Atasever A, Çiyiltepe H, Fersahoğlu MM, Esen Bulut N, et al. Investigation of the effect of weight loss after laparoscopic sleeve gastrectomy on Cobb angle, waist and back pain: a prospective study. *Surg Obes Relat Dis*. 2023 Dec;19(12):1357–65. doi:10.1016/j.soard.2023.07.010 PubMed PMID: 37673710.
- Mele C, Caputo M, Ferrero A, Daffara T, Cavigiolo B, Spadaccini D, et al. Bone Response to Weight Loss Following Bariatric Surgery. *Front Endocrinol (Lausanne)*. 2022;13:921353. doi:10.3389/fendo.2022.921353 PubMed PMID: 35873004; PubMed Central PMCID: PMC9301317.
- Passias PG, Horn SR, Ihejirika YU, Vasques-Montes D, Segreto FA, Bortz CA, et al. Bariatric Surgery Population at Significantly Increased Risk of Spinal Disorders and Surgical Intervention Compared With Morbidly Obese Patients. *Clin Spine Surg*. 2020 May;33(4):E158–61. doi:10.1097/BSD.0000000000000960 PubMed PMID: 32168118.
- Schafer AL, Kazakia GJ, Vittinghoff E, Stewart L, Rogers SJ, Kim TY, et al. Effects of Gastric Bypass Surgery on Bone Mass and Microarchitecture Occur Early and Particularly Impact Postmenopausal Women. *J Bone Miner Res*. 2018 Jun;33(6):975–86. doi:10.1002/jbmr.3371 PubMed PMID: 29281126; PubMed Central PMCID: PMC6002877.
- Pfirrmann CWA, Metzendorf A, Zanetti M, Hodler J, Boos N. Magnetic Resonance Classification of Lumbar Intervertebral Disc Degeneration. *Spine*. 2001 Sep 1;26(17):1873.
- Wáng YXJ, Wáng JQ, Káplár Z. Increased low back pain prevalence in females than in males after menopause age: evidences based on synthetic literature review. *Quantitative Imaging in Medicine and Surgery*. 2016 Apr;6(2):19906–19206. doi:10.21037/qims.2016.04.06
- Lee CA, Jang HD, Moon JE, Han S. The Relationship between Change of Weight and Chronic Low Back Pain in Population over 50 Years of Age: A Nationwide Cross-Sectional Study. *Int J Environ Res Public Health*. 2021 Apr 9;18(8):3969. doi:10.3390/ijerph18083969 PubMed PMID: 33918755; PubMed Central PMCID: PMC8069450.
- Lidar Z, Behrbalk E, Regev GJ, Salame K, Keynan O, Schweiger C, et al. Intervertebral Disc Height Changes After Weight Reduction in Morbidly Obese Patients and Its Effect on Quality of Life and Radicular and Low Back Pain: *Spine*. 2012 Nov;37(23):1947–52. doi:10.1097/BRS.0b013e31825fab16
- Vincent HK, Ben-David K, Conrad BP, Lamb KM, Seay AN, Vincent KR. Rapid changes in gait, musculoskeletal pain, and quality of life after bariatric surgery. *Surg Obes Relat Dis*. 2012;8(3):346–54. doi:10.1016/j.soard.2011.11.020 PubMed PMID: 22336495.
- Khoueir P, Black MH, Crookes PF, Kaufman HS, Katkhouda N, Wang MY. Prospective assessment of axial back pain symptoms before and after bariatric weight reduction surgery. *The Spine Journal*. 2009 Jun;9(6):454–63. doi:10.1016/j.spinee.2009.02.003
- Johnston BC, Kanters S, Bandayrel K, Wu P, Naji F, Siemieniuk RA, et al. Comparison of Weight Loss Among Named Diet Programs in Overweight and Obese Adults: A Meta-analysis. *JAMA*. 2014 Sep 3;312(9):923. doi:10.1001/jama.2014.10397
- Samartzis D, Karppinen J, Cheung JPY, Lotz J. Disk Degeneration and Low Back Pain: Are They Fat-Related Conditions? *Global Spine Journal*. 2013 Jun;3(3):133–43. doi:10.1055/s-0033-1350054
- Wong AY, Karppinen J, Samartzis D. Low back pain in older adults: risk factors, management options and future directions. *Scoliosis*. 2017 Dec;12(1):14. doi:10.1186/s13013-017-0121-3
- Urquhart DM, Kurniadi I, Triangto K, Wang Y, Wluka AE, O'Sullivan R, et al. Obesity Is Associated With Reduced Disc Height in the Lumbar

- Spine but Not at the Lumbosacral Junction: Spine. 2014 Jul;39(16):E962–6. doi:10.1097/BRS.0000000000000411
24. George SZ, Fritz JM, Silfies SP, Schneider MJ, Beneciuk JM, Lentz TA, et al. Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021: Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health From the Academy of Orthopaedic Physical Therapy of the American Physical Therapy Association. Journal of Orthopaedic & Sports Physical Therapy. 2021 Nov;51(11):CPG1–60. doi:10.2519/jospt.2021.0304
25. Cannata F, Vadalà G, Ambrosio L, Fallucca S, Napoli N, Papalia R, et al. Intervertebral disc degeneration: A focus on obesity and type 2 diabetes. Diabetes Metabolism Res. 2020 Jan;36(1):e3224. doi:10.1002/dmrr.3224
26. Che YJ, Guo JB, Liang T, Chen X, Zhang W, Yang HL, et al. Assessment of changes in the micro-nano environment of intervertebral disc degeneration based on Pfirrmann grade. The Spine Journal. 2019 Jul;19(7):1242–53. doi:10.1016/j.spinee.2019.01.008
27. Whatley BR, Wen X. Intervertebral disc (IVD): Structure, degeneration, repair and regeneration. Materials Science and Engineering: C. 2012 Mar;32(2):61–77. doi:10.1016/j.msec.2011.10.011

CASE SERIES

Midterm Clinical and Radiological Outcomes of Total Hip Arthroplasty in Protrusio Acetabuli, Using Novel Technique of Head of Femur as an Autograft – A Case Series

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Purpose: Total hip arthroplasty (THA) in protrusio acetabuli is challenging as it requires the use of massive bone grafts (auto or allograft) along with a wire mesh or reinforcement ring or cage to prevent medial migration of the graft or prosthesis into pelvis. However, there are significant disadvantages associated with use of these devices. The purpose of this study is to assess outcomes of THA in hip protrusion with acetabular defect grade 2 or more, using a novel technique of femoral head used as autograft, without the use of any protrusio ring, wire mesh, or cage.

Methodology: This case series included seven patients, with age 18 years or more and grade 2 or more protrusio acetabuli, who underwent total hip arthroplasty by a single fellowship-trained surgeon between 2019 and 2024. Patient demographics such as age, sex, comorbidities, body mass index (BMI), protrusio grade, etiology, bearing surfaces, along with clinical findings such as intra- and post-operative complications, Oxford Hip Score (OHS), follow up duration etc. were recorded. The Mann–Whitney U test compared functional outcomes between dual mobility and fixed bearing implants, while Spearman's rank correlation assessed associations between BMI and Oxford hip Score, and between protrusio grade and Oxford Hip Score.

Results: Seven female patients were included, with a mean age of 51.9 years and mean body mass index of 29.9 kg/m². Five patients had bilateral disease, with two undergoing single-stage bilateral total hip arthroplasty. Etiologies included rheumatoid arthritis (n=3), prior femoral neck fracture (n=1), history of tuberculosis hip (n=1), steroid and immunosuppressive use (n=1), and unknown cause (n=1). Hypertension was the most frequently observed comorbidity (43%). Mean follow-up was 28.9 months. No complications such as infection, dislocation, aseptic loosening, or periprosthetic fracture were observed. All autologous grafts demonstrated radiographic incorporation. The mean Oxford Hip Score was 39.9, with good (71.4%) to excellent (28.6%) outcomes in all patients. Functional outcomes did not differ between dual mobility and fixed bearing implants ($p = 1.00$). Moderate positive correlations were observed between OHS and BMI ($\rho = 0.625$) and between OHS and protrusion grade ($\rho = 0.670$).

Conclusion: Novel technique of using femur head autograft is an excellent biological method to fill acetabular medial defects during THA, while avoiding complications related to reinforcement devices.

Keywords: Protrusio acetabuli, Total hip arthroplasty, Oxford hip score, Morselized femoral head autograft, Autologous femoral head autograft, Autograft, Case series

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Introduction

In developing countries such as Pakistan, people with hip pain usually present late when symptoms have worsened enough to cause disability¹. Furthermore, the overall prevalence of protrusio acetabuli remains unknown because it varies across specific populations². The etiologies of protrusio acetabuli are vast because it can stem from a primary idiopathic disorder or from secondary causes including trauma, malignancy, infection, paget disease, and inflammatory conditions such as

rheumatoid arthritis (RA) and psoriatic arthritis^{2,3}. In diseases like rheumatoid arthritis and tuberculosis (TB) hip, if patient continues to bear weight on the osteoporotic joint, it causes bony erosion, creating a large structural defect in the acetabular cavity, followed by medial migration of the femur head leading to a protrusion⁴. Ideal treatment of these cases is total hip arthroplasty (THA). THA in protrusio is challenging as it requires the use of massive bone grafts (auto or allograft) along with a wire mesh or reinforcement ring or cage to prevent medial migration of the graft or prosthesis into pelvis^{2,5}. In

young patients, these additional biomaterials tend to loosen early. Also, excessive use of metallic implants poses a risk of reactivation of infection in the long term. There are a few techniques described in literature for using a femoral head autograft to reconstruct the large structural defects^{6,7}. In our technique we used femoral head as autograft to fill the acetabular defect. In such situations, graft incorporation and healing is a very important factor, so is recreation of center of rotation of hip².

Methodology

From 2019 to 2024, we searched the hospital electronic database and files of patients who presented with hip pain or disability secondary to protrusio acetabuli, and underwent THA by a single surgeon using our specific technique. Patient's personal information was de-identified. Series of 7 patients were included with age more than 18 years having protrusio greater than 1 (2 or more). Patient demographics such as age, sex, comorbidities, body mass index (BMI), addiction, cause of protrusio, procedure, intraoperative complications, intraoperative blood loss, bearing surfaces used, protrusio grade using x-rays, length of stay (LOS), Oxford Hip Score (OHS), postoperative complications etc. were recorded. Patients having grade 1 protrusio, operated by other surgeon, or operated by other techniques were excluded. After approval from the ethics review committee, data collection was started. Preoperative X-rays were reviewed by fellow arthroplasty. Protrusio was calculated using pelvis anteroposterior x-rays by measuring the distance from Kohler line/ilioischial line and the most medial cortex, as shown in figure 1. Protrusio was classified using Sotelo-Garza/Charnley classification⁸, as shown in table 1. All patients were operated in lateral position using posterior approach by a single fellowship trained arthroplasty surgeon. Same technique was utilized in all patients. The Mann-Whitney U test was used to compare postoperative Oxford Hip Scores between the dual mobility group and the fixed bearing group. Median and interquartile ranges (IQR) were reported for each group. Spearman's rank correlation coefficient (ρ) was used to analyze the relationship between BMI and Oxford Hip Score, and between protrusio grade and Oxford Hip Score. A scatter plot was generated to visualize the correlation. A p-value of <0.05 was considered statistically significant.



Figure 1: Grade 3 protrusio (20.6 mm)

Table 1

Grade	Distance between kohler line and acetabulum
1	1-5 mm (mild protrusio)
2	6-15mm (moderate protrusio)
3	>15 mm (severe protrusio)

Technique

Severe protrusio acetabuli is a unique challenge in hip arthroplasty because of bone altered anatomy, bone defects and hence unreliable long-lasting reconstruction. Options include acetabular cages, metal augments and multihole cups with or without bone cement and bone graft.

Our technique is simple, cost effective and biological with good results and reliable for long term survival. After dislocating the hip, neck osteotomy was performed, in fact in situ osteotomy was performed in case hip was not dislocatable (figure 2). All fibrous tissue was carefully debrided from the head surface and the acetabular lining after dislocation. We then aimed to ream only the acetabular outlet area with the best fitting acetabular size just enough to snugly fit the outer side of the acetabulum (figure 3). The same reamer was then placed on the osteotomized head and neck fragment starting from the neck region and the bone was resected according to the circumference of the reamer (figure 4). The remaining bone was debrided and cleaned and used to fill the rest of the acetabulum medially (figure 5). The rest of the bone from the neck region was morselized to be used as graft filling the voids across the acetabulum with the strut and shaped up acetabular graft. The cup size was selected based on the reamer size and the cup was impacted with the strut shaped up and the morselized bone graft (figure 6). The position was secured with screws through the bone graft and the remaining acetabular bone. As the strut graft was inherently sclerotic, it helped to secure the screws rather firmly. A primary hip implant with no metal cages or augments were used naturally reducing the cost. Patient was kept non weight bearing for few weeks till the graft

was incorporated. Once signs of incorporation were seen on follow-up x-rays, weight bearing was gradually started and progressed as tolerated. The surgeon experience and confidence play a vital role and the technique worked successfully in all of our patients without any untoward difficulty or complication.

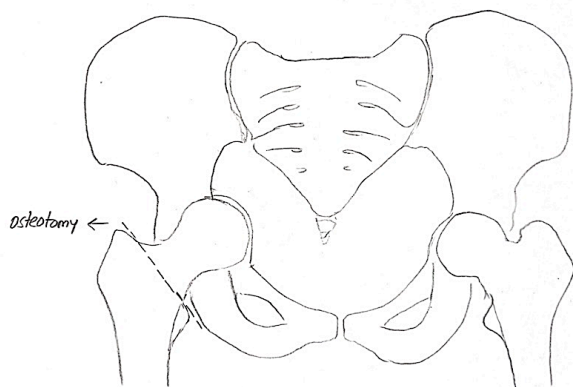


Figure 2

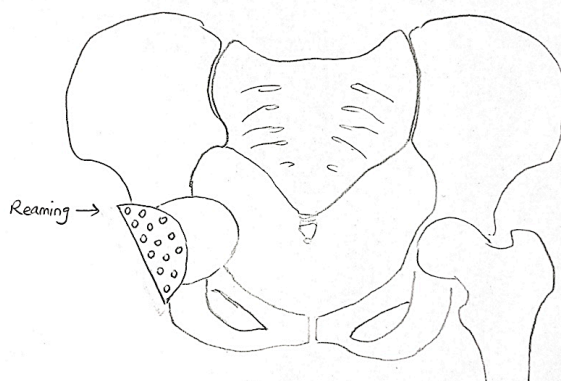


Figure 3

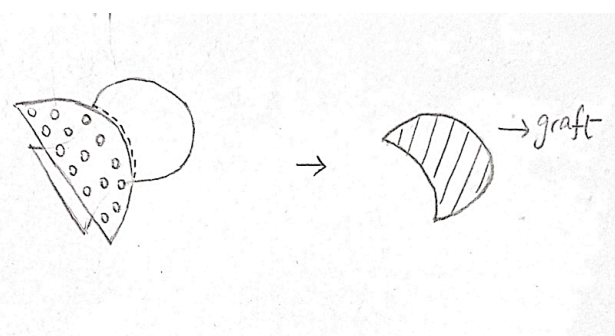


Figure 4

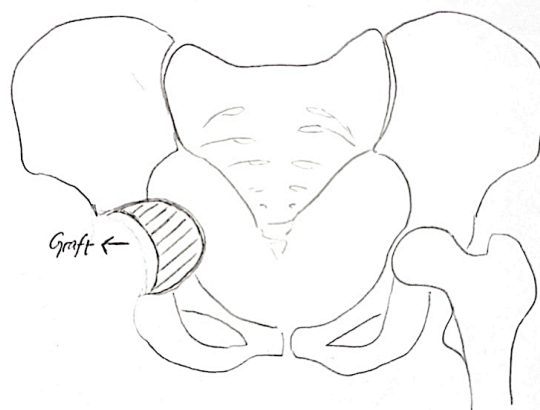


Figure 5

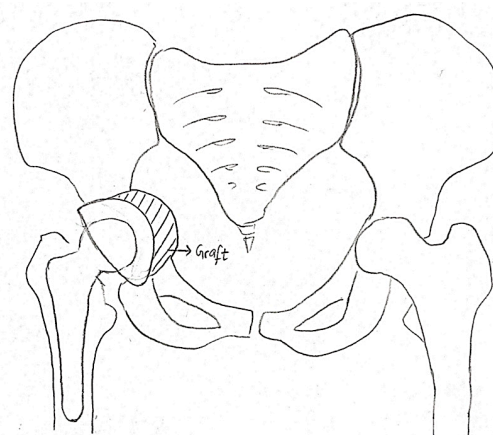


Figure 6

Results

A total of seven patients were included in this case series; all were female, with a mean age of 51.9 ± 18.4 years (range: 26–75 years). Five of the seven patients presented with bilateral hip pain secondary to protrusio acetabuli. The mean duration of symptoms prior to presentation was 5.0 ± 1.9 years (range: 3–8 years). Rheumatoid arthritis was identified as the underlying cause in three patients. Among the remaining patients, one had a previous conservatively managed fracture of the femoral neck, one had a history of tuberculosis hip, one developed protrusio following prolonged steroid and immunosuppressive therapy after renal transplant, and in one patient no clear etiology could be determined. Hypertension was the most frequently observed comorbidity (43%), followed by diabetes mellitus, hypothyroidism, and chronic kidney disease (each 14%). The mean BMI was 29.9 ± 2.5 kg/m², with six patients classified as overweight or obese. None of the patients reported any addiction or history of smoking.

Radiographically, four patients demonstrated Grade II protrusio and three demonstrated Grade III protrusio. Two patients underwent single-stage bilateral primary total hip arthroplasty (THA), while one patient required a staged bilateral procedure. Rest of the four patients underwent unilateral THA. The mean length of stay was 6.1 ± 2.0 days (range: 3–9 days), and the

mean intraoperative blood loss was 238.6 ± 38.0 ml. All procedures were performed by the same arthroplasty-trained surgeon using a posterior approach in the lateral position. Metal-on-polyethylene dual mobility bearings were used in 71.4% (n=5) of hips, while ceramic-on-polyethylene fixed bearings were used in 28.6% (n=2) (figure 7).

The mean follow-up duration was 28.9 ± 13.3 months (range: 12–52 months). Postoperative functional outcomes assessed using the Oxford Hip Score demonstrated a mean score of 39.9 ± 2.0 (range: 38–43). Scores of 42–48 were categorized as excellent and 34–41 as good; 28.6% (n=2) of patients achieved excellent outcomes, while 71.4% (n=5) achieved good outcomes. Importantly, no intraoperative or postoperative complications were observed, including prosthetic joint

infection, periprosthetic fracture, heterotopic ossification, dislocation, or aseptic loosening during the follow-up period. All autologous bone grafts demonstrated successful incorporation at final follow-up (Figure 8).

Comparison between dual mobility and fixed-bearing THA revealed no statistically significant difference in functional outcomes (Mann–Whitney $U = 5$, $p = 1.00$) (Table 4). The association between Oxford Hip Scores and BMI revealed a moderate positive correlation (Spearman's $\rho = 0.625$) (Figure 9). Similarly, a moderate positive correlation was also found between Oxford Hip Scores and protrusio grade (Spearman's $\rho = 0.670$) (Figure 10). However, both these correlations did not reach statistical significance ($p > 0.05$).

Table 2: Demographics

Variables	Variables	Mean $\pm$ SD	Frequency (%)
Age (years)	Age (years)	51.9 ± 18.4	
Gender	Female		7 (100)
Gender	Male		0 (0)
BMI (km/m ²)	BMI (km/m ²)	29.9 ± 2.3	
Cause of protrusio	Neck of femur fracture		1 (14.3)
Cause of protrusio	Tuberculosis of hip		1 (14.3)
Cause of protrusio	Steroid induced		1 (14.3)
Cause of protrusio	Rheumatoid Arthritis		3 (42.9)
Cause of protrusio	Unclear etiology		1 (14.3)
Comorbidities	Diabetes Mellitus		1 (14.3)
Comorbidities	Hypertension		3 (42.9)
Comorbidities	Hypothyroidism		1 (14.3)
Comorbidities	Chronic kidney disease		1 (14.3)
Duration of symptoms (years)	Duration of symptoms (years)	5.0 ± 1.9	
Grade of protrusio	Grade 2		4 (57.1)
Grade of protrusio	Grade 3		3 (42.9)
Side involved	Bilateral		5 (71.4)
	Right		2 (28.6)
Side operated	Bilateral (single stage)		2 (28.6)
	Bilateral (two staged)		1 (14.3)
	Right		3 (42.9)
	Left		1 (14.3)

Table 3: Clinical outcome variables

Variables	Variables	Mean $\pm$ SD	Frequency (%)
Intraoperative blood loss (ml)	Intraoperative blood loss (ml)	238.6 ± 38.0	
Length of stay (days)	Length of stay (days)	6.1 ± 2.0	
Oxford hip score (OHS)	Oxford hip score (OHS)	39.9 ± 2.0	
	Excellent (OHS 42–48)		2 (28.6)
	Good (OHS 34–41)		5 (71.4)

Complications	Complications		0 (0)
Follow up duration (months)	Follow up duration (months)	28.9 ± 13.3	

Table 4

Implant type	Oxford hip score – median (IQR)
Dual mobility	40 (38 – 43)
Fixed bearing	40 (38 – 42)

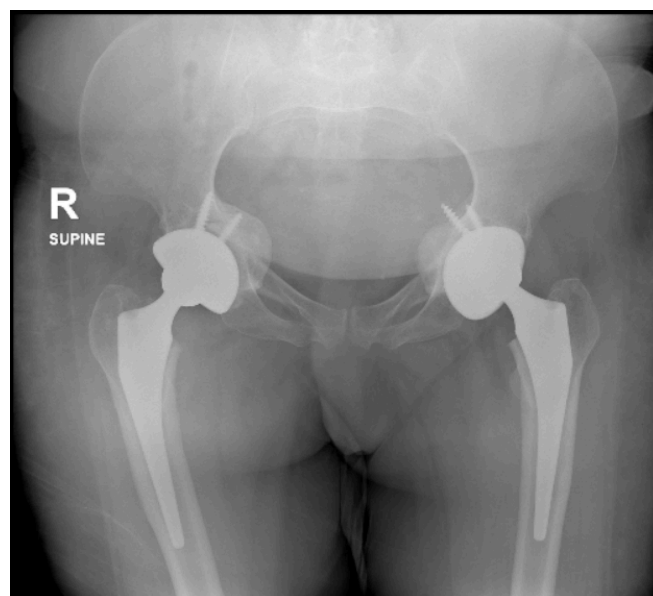


Figure 8: 75-year-old lady with bilateral protrusio acetabuli (grade 3). Bilateral THA (single stage) using head as autograft at 14 months follow up.

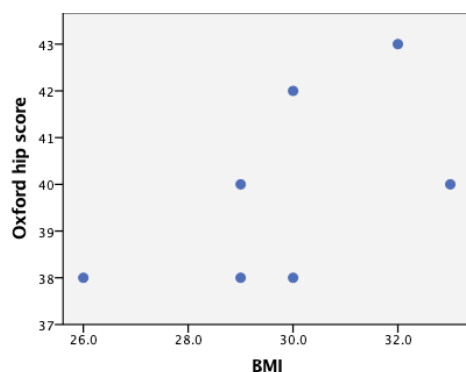


Figure 9 Association of BMI and Oxford Hip Score (Spearman's $\rho = 0.625$)

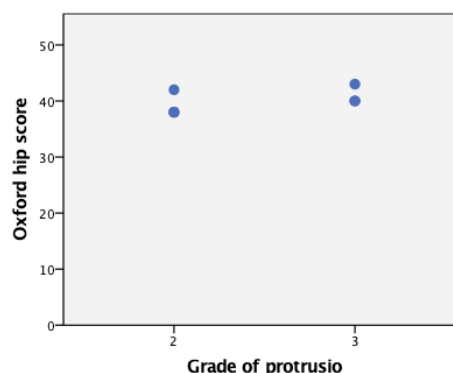


Figure 10 Association between protrusio grade and Oxford Hip Score (Spearman's $\rho = 0.670$)

Discussion

In this case series, we report the mid-term clinical and radiological outcomes of THA performed for moderate to severe protrusio acetabuli using a novel technique in which the femoral head is utilized as an autologous structural graft without the use of reinforcement rings, cages, wire mesh, or additional metallic augmentation. Our results demonstrate that this technique is safe, reproducible, and provides reliable functional improvement with excellent graft incorporation and absence of major complications at a mean follow-up of 28.9 months. The management of protrusio acetabuli remains challenging due to medial acetabular bone loss, altered hip

biomechanics, and increased risk of implant migration⁹. Traditional approaches frequently involve impacted bone grafting combined with reinforcement rings or cages to prevent medial cup migration. However, literature consistently highlights the disadvantages of these devices, including complexity of surgical exposure, increased cost, potential long-term loosening, and risk of infection reactivation¹. Similarly, previous reports have shown that uncemented or cemented cups placed directly into a deficient medial wall without proper bone grafting carry a high risk of loosening due to thermal necrosis and poor mechanical support¹⁰. In contrast, our technique utilizes the patient's own femoral head as structural autograft, offering biological advantages including superior osteoconductive and osteoinductive properties, complete host-graft compatibility, and elimination of disease-transmission risk inherent to allografts. Similar to the findings of Kushwaha et al., who used femoral head autograft in post-tubercular protrusio hips with excellent consolidation and functional recovery, our results confirm that adequate graft impaction into a well-prepared, vascular host bed provides stable support for acetabular component placement and medial defect reconstruction¹. The functional outcomes in our cohort were encouraging, with all patients achieving good to excellent Oxford Hip Scores (OHS). Notably, we did not observe any case of graft collapse, cup migration, aseptic loosening, periprosthetic fracture, or dislocation during the follow-up period. This complication-free course compares favorably with current literature, where complication rates were higher in cases involving reinforcement cages or cemented cups without bone grafting³. Our findings are also consistent with previous reports describing stable outcomes of autograft reconstruction for protrusio acetabuli in rheumatoid arthritis and other etiologies of protrusio acetabuli⁹. Furthermore, the underlying causes of protrusio, which included rheumatoid arthritis, steroid use, chronic kidney disease, TB hip, and previous conservatively treated femoral neck fracture, did not influence graft incorporation or post-operative hip function. This reinforces the biological advantage of using autologous bone, even in metabolically compromised or osteoporotic bone states.

An interesting observation in our study was that there was a moderate positive correlation between BMI and Oxford Hip Score, as well as between protrusion grade and Oxford Hip score, indicating a trend toward higher functional scores with increasing BMI and protrusio grade. However, both these correlations were not statistically significant, likely due to the small sample size.

A key strength of our study is that all procedures were performed by a single fellowship-trained arthroplasty surgeon using a standardized posterior approach, eliminating inter-surgeon variability. In addition, three patients underwent bilateral THA (single-stage or staged), emphasizing the feasibility of this technique even in complex bilateral disease.

However, certain limitations deserve consideration. First, our sample size is small (n=7), limiting generalizability. Second, the absence of a control group—such as patients treated with cages or allografts—prevents direct comparative analysis. Third, although our follow-up duration of up to 52 months provides meaningful mid-term insight, longer surveillance is necessary to evaluate the durability of graft integration, the potential for late loosening, and survivorship of implants. Fourth, this study does not include a direct comparison of outcomes between unilateral, bilateral staged, and bilateral single-staged THA. Despite these limitations, the study offers meaningful evidence supporting the use of femoral head autograft in THA for significant protrusio acetabuli. Our outcomes are in line with existing literature advocating that adequate graft impaction with a well-positioned uncemented cup can restore hip biomechanics, improve medial bone stock, and avoid the complications associated with reinforcement devices¹.

Conclusion

Use of femoral head as an autograft is valuable in case of hip pathologies with acetabular defect and protrusio acetabuli, in patients planned for THA. It provides a biological environment for acetabular defect healing and avoids cost and complications associated with metallic cages, rings or meshes.

Conflict of interest: No financial conflict of interest to disclose.

References

1. Kushwaha NS, Singh A, Saroj AK, Verma A, Ansari KA. Protrusio acetabuli in tubercular hip: Outcome of femoral head as autologous bone graft used during total hip replacement. *J Clin Orthop Trauma*. 2023 Sep;44:102247. doi:10.1016/j.jcot.2023.102247 PubMed PMID: 37822476; PubMed Central PMCID: PMC10562844.
2. Lum ZC, Dorr LD. Restoration of center of rotation and balance of THR. *J Orthop*. 2018 Sep 6;15(4):992–6. doi:10.1016/j.jor.2018.08.040 PubMed PMID: 30224857; PubMed Central PMCID: PMC6138845.
3. Greig D, Hsiue PP, Chen CJ, Trikhia R, Khoshbin A, Stavrakis AI. Outcomes of Total Hip Arthroplasty in Patients With Acetabular Protrusio. *J Am Acad Orthop Surg Glob Res Rev*. 2020 Jul;4(7):e2000121. doi:10.5435/JAAOSGlobal-D-20-00121 PubMed PMID: 33969953; PubMed Central PMCID: PMC7375486.
4. Vaishya R. Bilateral protrusio acetabuli of the hip. *BMJ Case Reports CP*. 2014 Mar 17;2014:bcr2013201784. doi:10.1136/bcr-2013-201784
5. Bayley JC, Christie MJ, Ewald FC, Kelley K. Long-term results of total hip arthroplasty in protrusio acetabuli. *J Arthroplasty*. 1987;2(4):275–9. doi:10.1016/s0883-5403(87)80059-1 PubMed PMID: 3430153.
6. Garcia-Cimbrelo E, Diaz-Martin A, Madero R, Munera L. Loosening of the cup after low-friction arthroplasty in patients with acetabular protrusion. The importance of the position of the cup. *J Bone Joint Surg Br*. 2000 Jan;82(1):108–15. doi:10.1302/0301-620x.82b1.9796 PubMed PMID: 10697325.
7. Ansari S, Gupta K, Gupta T, Raja BS, J P, Kalia RB. Total Hip Arthroplasty in Protrusio Acetabuli: A Systematic Review. *Hip Pelvis*. 2024 Mar 1;36(1):12–25. doi:10.5371/hp.2024.36.1.12 PubMed PMID: 38420735; PubMed Central PMCID: PMC10929539.
8. Managing Native Hip Protrusio: Simplified Classification and Surgical Recommendations [Internet]. [cited 2026 May 11]. Available from:



<https://www.mdpi.com/2673-4036/3/1/5>

9. Zhen P, Li X, Zhou S, Lu H, Chen H, Liu J. Total hip arthroplasty to treat acetabular protrusions secondary to rheumatoid arthritis. *J Orthop Surg Res.* 2018 Apr 19;13(1):92. doi:10.1186/s13018-018-0809-y PubMed PMID: 29673377; PubMed Central PMCID: PMC5907719.

10. Primary total hip arthroplasty in protrusio acetabuli using impacted morsellized bone grafting and cementless cups: a medium-term radiographic review - PubMed [Internet]. [cited 2026 May 11]. Available from: <https://pubmed.ncbi.nlm.nih.gov/18078883/>

CASE SERIES

Periprosthetic Distal Femur Fractures after Total Knee Arthroplasty: A Three-Case Experience from a Resource-Constrained LMIC Tertiary Care Center

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Background: Periprosthetic distal femur fractures (PDFFs) following total knee arthroplasty (TKA) are increasingly encountered in elderly patients. These fractures present a complex challenge, particularly in low- and middle-income countries (LMICs) where implant options and surgical infrastructure may be limited.

Case Presentation: We present three elderly female patients with PDFFs managed at a tertiary care center in Pakistan. All cases involved low-energy trauma and well-fixed TKA components. Diagnostic evaluation included radiographs and CT imaging with metal artifact reduction. Patients were treated using three distinct strategies: (1) open reduction and internal fixation (ORIF) with a locking plate; (2) retrograde intramedullary nailing with insert exchange; and (3) distal femoral megaprosthesis for a comminuted fracture with poor bone stock. All patients were optimized preoperatively and followed for six months, showing satisfactory radiographic and functional outcomes.

Conclusions: In LMICs, where modular revision total knee implants may be unavailable, osteosynthesis and megaprosthesis reconstruction remain the most accessible and effective options. Careful surgical planning and patient selection are critical to achieving favorable outcomes even within resource-limited environments.

Keywords: Periprosthetic fracture; total knee arthroplasty; distal femur; locking plate; retrograde nail; megaprosthesis; LMIC

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Introduction

Periprosthetic distal femur fractures (PDFFs) are increasingly observed as the number of total knee arthroplasties (TKAs) rises globally, particularly among aging populations^{1,2}. Registry data indicates an incidence of 0.3%–2.5% in primary TKAs, with significantly higher rates in octogenarians and patients with underlying osteoporosis or frailty^{3,4}. The pathophysiology of PDFFs is multifactorial, with low-energy falls, implant-related stress shielding, and decreased cortical bone integrity contributing to fracture susceptibility in the elderly⁵. Female patients are disproportionately affected, partly due to postmenopausal osteoporosis and sarcopenia^{3,6}. In high-income countries, advanced implant systems and perioperative infrastructure support timely surgical management. However, in LMICs, limited access to revision implants, variable quality of prosthetics, and financial constraints challenge standard treatment algorithms^{1,7}. Despite these barriers, some tertiary care centers in resource-constrained regions now have access to locking plates, retrograde nails, and oncologic megaprotheses, enabling tailored interventions.

Classification systems such as those by Lewis and Rorabeck and Su et al. help guide surgical planning by stratifying fractures based on implant stability and fracture morphology. Internal fixation techniques like locking plate osteosynthesis (LPO) and retrograde intramedullary nailing (RIMN) remain primary strategies when the implant is well-fixed and bone stock is sufficient⁸. In cases of significant bone loss or loose implants, reconstruction with a distal femoral megaprosthesis (DFM) may be necessary^{7,9}.

This case series presents three elderly female patients managed using diverse surgical strategies at a tertiary-level LMIC hospital, illustrating the adaptability required in low-resource environments.

Case Presentations

Case 1:

A 70-year-old woman with diabetes and ischemic heart disease sustained a supracondylar fracture around a well-fixed TKA. A midline incision was used to confirm implant stability, followed by lateral exposure and ORIF with a distal femur locking plate in bridge mode. The patient progressed from bed-to-chair mobilization postoperatively to full weight-bearing at six weeks, with union confirmed by six months. [Fig 1]



Figure 1: Case 1 – pre-operative, intra-operative fluoroscopic and post-operative radiographs following locking-plate osteosynthesis of a periprosthetic distal femur fracture around a well-fixed total knee arthroplasty.

Case 2:

A 70-year-old woman with renal insufficiency and COPD presented with a PDFF. A metal reduction sequence CT scan was suggestive of a well-fixed implant. After medical optimization, we proceeded with a midline approach to the

knee joint to confirm stability of the implant. Followed by retrograde intramedullary nailing and polyethylene insert exchange. Full weight-bearing was achieved at six weeks, and fracture healing was radiographically complete by six months. [Fig 2]



Figure 2: Case 2 – pre-operative, intra-operative fluoroscopic and post-operative radiographs following retrograde intramedullary nailing.

Case 3:

A 69-year-old woman, recently operated for bilateral TKA, sustained a PDFF following a fall on post op day 15. Imaging showed extensive bone loss and compromised metaphysis.

Given the unavailability of revision implants, the team proceeded with a distal femoral megaprosthesis reconstruction. The patient completed rehabilitation and returned to full assisted ambulation by six months, without complications. [Fig 3]

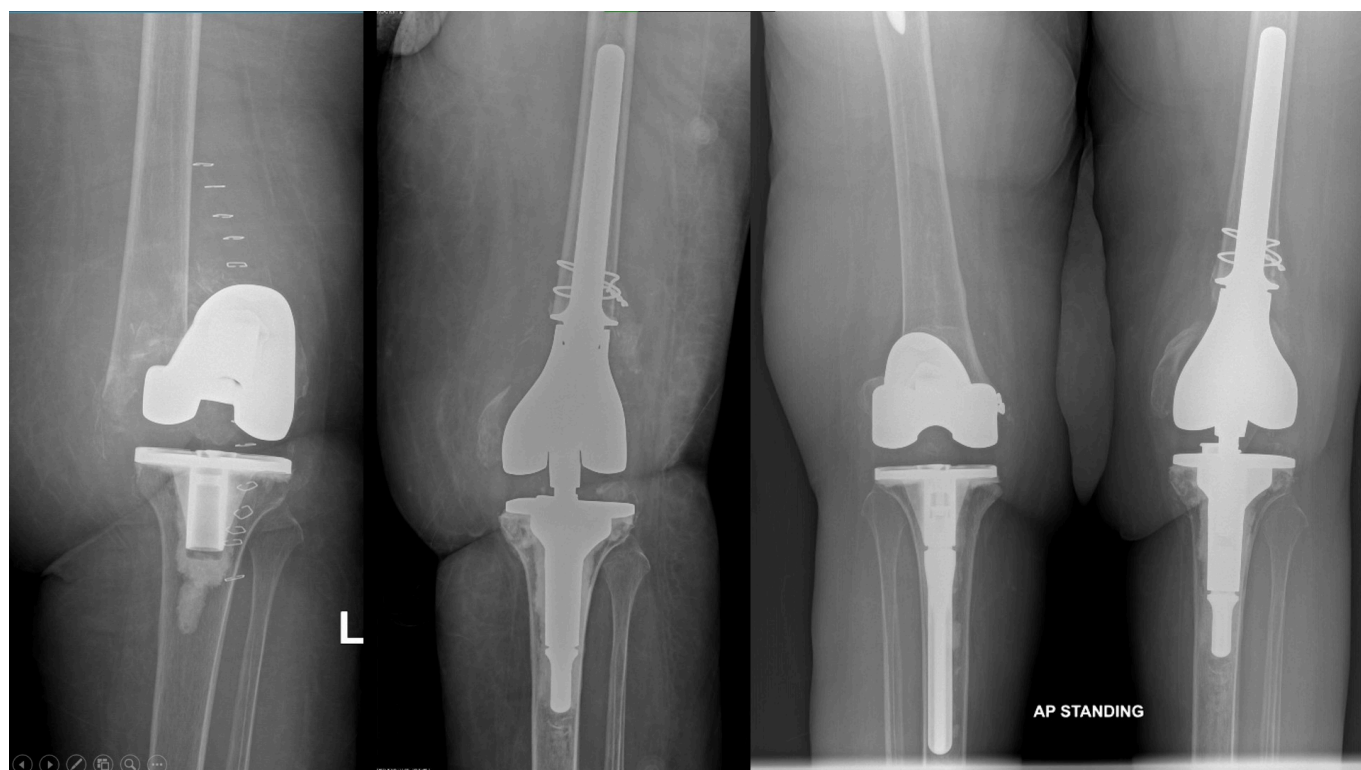


Figure 3: Case 3 – pre-operative, intra-operative and post-operative radiographs of the reconstruction.

Discussion

Periprosthetic distal femur fractures (PDFFs) represent a growing orthopedic challenge due to increasing total knee arthroplasty (TKA) volumes and extended life expectancy globally^{2,4}. The elderly are particularly vulnerable, with low-energy trauma being the most common mechanism of injury^{3,4}. These fractures are further complicated by reduced bone mineral density, comorbidities, and impaired healing capacity^{4,6}. In patients with a stable implant and preserved bone stock, internal fixation is generally preferred. Both locking plate osteosynthesis (LPO) and retrograde intramedullary nailing (RIMN) are validated strategies with comparable union rates and complication profiles⁸. A 2021 meta-analysis found no significant difference in time to union or non-union rates between the two modalities, although locking plates may provide enhanced stability in osteoporotic or comminuted fractures⁹. Our first two cases support this approach, with both patients achieving fracture union and early mobilization. When significant metaphyseal bone loss is present, or when the femoral component is loose, the treatment algorithm shifts toward reconstruction. Ideally, this would involve revision total knee arthroplasty (rTKA) using modular stems and augments. However, in LMICs, these systems are often unavailable due to supply chain limitations or cost constraints.

Consequently, surgeons in these environments may need to resort to megaprosthesis constructs (typically designed for oncologic resections) as a salvage solution for non-tumor indications such as severe PDFFs⁷. Megaprosthesis reconstruction offers immediate weight-bearing capability and high construct stability, which is particularly advantageous in elderly patients with limited rehabilitation potential. Though cost-intensive and associated with specific risks such as aseptic loosening or extensor mechanism disruption, they remain a viable and often the only reconstructive option in many LMIC tertiary centers^{1,7}. A recent European multicenter study reported that 85% of elderly patients undergoing distal femoral megaprosthesis (DFM) for non-oncologic indications regained assisted ambulation within six weeks¹⁰. Our third case mirrored these findings, highlighting the utility of this approach in the absence of standard revision implants.

Preventive measures are equally important in mitigating PDFF risk. Osteoporosis management, fall-risk screening, perioperative nutritional optimization, and prehabilitation should be embedded into arthroplasty protocols for elderly patients^{4,6,10}. In LMIC settings, where treatment options may be limited, prevention becomes even more critical. This case

series has limitations. It presents only three cases with six months of follow-up and does not include standardized patient-reported outcomes. Advanced imaging such as weight-bearing CT was unavailable, which could have enhanced fracture assessment. However, the cases presented reflect real-world surgical adaptation in resource-limited environments and reinforce the role of multidisciplinary planning and tailored surgical intervention. PDFFs are complex injuries requiring nuanced decision-making. In settings where revision TKA systems are unavailable, osteosynthesis and megaprosthesis represent the primary surgical pathways. Careful case selection, interdisciplinary care, and use of available implant technologies can yield favorable outcomes, even under constrained circumstances.

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Funding: No external funding was received for this study.

Ethics Approval: This case series was conducted in accordance with institutional ethical standards.

References

- Alenazi B, Alkhalifah M, Alharbi A, Alhudhaif H. Risk factors influencing management outcomes of periprosthetic fractures following total knee arthroplasty: a retrospective study. *Research Square* [Preprint]. 2025. Available from: <https://www.researchsquare.com/article/rs-8058295/latest>
- Förch S, Mayr E. Prothesenwechsel distales Femur: Strategien bei Versagen der Osteosynthese im Alter. *OP-Journal*. 2025. doi:10.1055/a-2591-4775
- Aguado HJ. Risk factors for one-year mortality in 440 femoral peri-implant fractures: insights from the PIPPAS prospective, multicentre, observational study. *Bone Joint Open*. 2025;6(1):1–8. doi:BJO-2024-0113.R110.1302/2633-1462.61
- Del Saz JS, Carretero JC, Coiradas JG, Crespo RG. Watch out your pins! Periprosthetic femoral fracture at tracking pin site early after robotic-assisted knee arthroplasty treated with dual nail-plate fixation. *Trauma Case Rep*. 2025;41:101809. doi:10.1016/j.tcr.2025.101809
- Enchev D, Malouchev O, Grivov N. Augmentation with frozen fibular graft in problematic distal femoral fractures and nonunions. *Orthop Proc*. 2025;7:58. doi:10.1302/1358-992X.2025.7.058
- Mitterer M, Freude T. Osteosynthese distales Femur: Indikationen und Techniken bei periprosthetischen Frakturen. *OP-Journal*. 2025. doi:10.1055/a-2507-9458
- Lunebourg A, Leclerc G, Parratte S. Outcomes of megaprosthesis reconstruction in elderly patients with distal femur fractures. *Eur J Orthop Surg Traumatol*. 2023;33(2):221–7. doi:10.1007/s00590-022-03203-4
- Lee SY, Choi YJ, Kim JH. Surgical strategies and outcomes in periprosthetic distal femoral fractures. *Clin Orthop Surg*. 2020;12(4):470–7. doi:10.4055/cios19115
- Ebraheim NA, Siddiqui S, Gohil S. Locking plate versus retrograde nailing for PDFFs: a meta-analysis. *Eur J Trauma Emerg Surg*. 2021;47(2):475–84. doi:10.1007/s00068-019-01258-5
- Pangaud C, Ollivier M, Argenson JN. Management of periprosthetic femoral fractures in the elderly. *Orthop Traumatol Surg Res*. 2021;107(1S):S109–18. doi:10.1016/j.otsr.2020.12.015

CASE REPORT

Staged Bilateral Total Hip and Knee Arthroplasties with Subsequent Hip Revisions in Juvenile Rheumatoid Arthritis: A Rare Case Report

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Background:

Juvenile idiopathic arthritis (JIA), previously termed juvenile rheumatoid arthritis (JRA), is a chronic inflammatory condition that can result in severe joint destruction if inadequately treated. While pharmacologic advancements have significantly reduced the need for surgery, a subset of patients with refractory disease may progress to end-stage arthritis requiring total joint arthroplasty (TJA). Surgical management in this population presents unique challenges due to young age, anatomical deformities, and long-term disease burden.

Case Presentation:

We report the rare case of a young adult with longstanding JIA who underwent staged bilateral total hip arthroplasty (THA), later requiring bilateral primary total knee arthroplasty (TKA) and simultaneous bilateral total hip revision surgeries. The patient had a history of severe joint deformity, limited mobility, and prolonged corticosteroid use. A unique surgical strategy was employed for this patient: a staged, simultaneous primary total knee arthroplasty combined with contralateral revision hip arthroplasty. Autologous bone obtained during the knee procedure was used to reconstruct the acetabular defect encountered during the hip revision. Through multidisciplinary planning and staged interventions, the patient achieved significant functional improvement and pain relief.

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Introduction

Juvenile idiopathic arthritis (JIA) is a chronic inflammatory condition that affects children under the age of 16 and can result in long-term joint damage, deformity, and disability if not adequately treated. Although advancements in medical management—particularly the use of disease-modifying antirheumatic drugs (DMARDs) and biologics—have significantly improved outcomes, a subset of patients with severe or refractory disease still progress to end-stage joint destruction requiring surgical intervention^{1,2}.

Total joint arthroplasty (TJA) in patients with JIA is challenging due to early-onset disease, long-term corticosteroid use, and osteopenia. While isolated hip or knee arthroplasties have been described in the literature for this population, the need for sequential bilateral total hip arthroplasty (THA) followed by bilateral total knee arthroplasty (TKA) and ultimately revision of both hips is rare and poses unique surgical and rehabilitation challenges^{3,4}.

The novelty of this case lies in the rare sequence of staged bilateral total hip arthroplasties (THA) and staged total knee

arthroplasty with contralateral revision THA in a young patient with juvenile idiopathic arthritis (JIA). While previous studies have reported outcomes of isolated THA or TKA in JIA patients, reports describing sequential four-joint arthroplasty followed by bilateral hip revisions are exceedingly rare. Swarup et al. reported favourable survivorship after THA in JIA, whereas Ledbetter et al. described favourable long-term outcomes following TKA; however, neither study described such extensive multi-joint reconstruction in a single patient. Another unique aspect of this case is the staged combined approach of performing primary TKA with contralateral revision THA during the same operative setting. Biological reconstruction techniques have been shown to restore bone stock and provide satisfactory long-term outcomes in young revision patients, as demonstrated by Schreurs et al. In our case, an autologous morselised bone graft harvested from knee arthroplasty bone cuts was utilised for acetabular reconstruction during revision THA. This case therefore highlights a rare and practical reconstructive strategy for managing severe multi-joint destructive disease in JIA.

Case Report

A 34-year-old male was diagnosed with juvenile rheumatoid arthritis at the age of 4 years. He was initially being managed with disease-modifying anti-rheumatic drugs (DMARDs) and corticosteroid therapy. At 17 years of age, he underwent staged bilateral total hip arthroplasty secondary to advanced erosive arthritis involving both hip joints. (Figure. 1 and Figure. 2).



Figure 1. Preoperative radiograph.

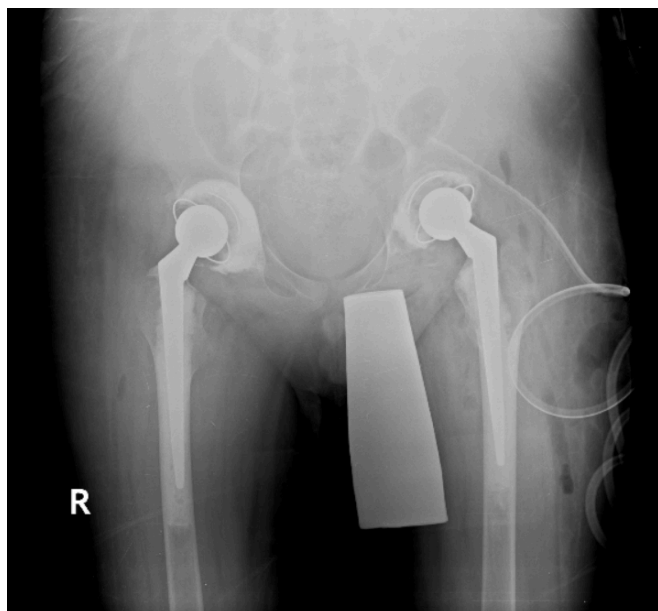


Figure 2. Preoperative radiograph.

Following surgery, he remained clinically stable until the age of 24 years – when he presented to our institution with bilateral knee pain associated with bilateral hip pain. Clinical examination revealed a 5° valgus deformity in both knees, with

flexion contractures of 20° on the right side and 10° on the left side. The range of motion of the knees was 20–100° on the right and 10–100° on the left. Bilateral hip movements were restricted and painful. Further evaluation demonstrated erosive arthritis involving both knees along with aseptic loosening of bilateral hip prostheses (Figure. 3 and Figure. 4).

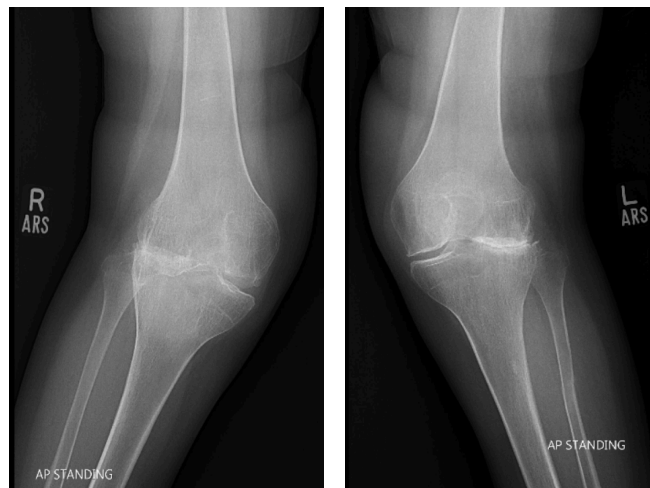


Figure 3. Radiographs at presentation, age 24.



Figure 4.

His treatment was planned in two stages.

Stage 1 – Revision Right Hip Replacement and Primary Left Total Knee Replacement

Stage 2 – Revision Left Hip Replacement and Primary Right Total Knee Replacement

Stage 1 – Revision Right Hip Replacement and Primary Left Total Knee Replacement

The patient initially underwent primary left total knee arthroplasty through a standard midline incision and medial parapatellar approach. Extensive hyperplastic synovium was excised, followed by bone preparation, soft tissue balancing, and implantation of the prosthesis.

Subsequently, the patient was repositioned for revision right hip arthroplasty using a posterior approach. The loosened acetabular component was removed, and acetabular reconstruction was performed using morselised autologous bone graft harvested from the knee arthroplasty bone cuts. A new acetabular component was implanted with supplementary screw fixation. The femoral stem was revised and re-cemented following femoral canal preparation, and the same femoral implant was retained.

Postoperatively, the patient was mobilised with full weight-bearing using a walker from postoperative day 1. Immediate postoperative radiographs demonstrated satisfactory implant alignment and soft tissue balancing, with complete correction of the deformity.

(Figure. 5 and Figure. 6).



Figure 5



Figure 6

Stage 2 – Revision Left Hip Replacement and Primary Right Knee Replacement

A similar staged procedure was subsequently performed on the contralateral side, consisting of primary right total knee arthroplasty followed by revision left total hip arthroplasty. An autologous bone graft harvested during the knee arthroplasty was again utilised for acetabular reconstruction during the hip revision procedure.

Postoperative radiographs demonstrated satisfactory implant positioning, stable fixation, and complete correction of the deformity with appropriate alignment and balancing. The patient was mobilised with full weight-bearing using walker assistance from the first postoperative day.

(Figure. 7 and Figure. 8).



Figure 7



Figure 8

The patient had been followed up regularly in the clinic for approximately 5 years and remained clinically well, with no active complaints related to the hip or knee joints. However, owing to the progressive nature of his disease, he frequently presented with aches and pains involving other joints of the body.

Implant Details

Hip Implants

	Right total hip replacement (2016)	Left total hip replacement (2017)
Femoral component (cemented)	Retained previously used femoral stem Zimmer implant (size 9) Taper neck, 110mm length	Retained previously used femoral stem Zimmer implant (size 9) Taper neck, 110mm length
Femoral head	Ceramic (36mm)	Ceramic (36mm)
Liner	Polyethylene (36mm inner diameter)	Polyethylene (40mm inner diameter)
Acetabular component (un-cemented)	United (U motion-2) 60 mm	United (U motion-2) 58 mm

Knee Implants

Age / Time Point	Clinical Event	Surgical Intervention / Outcome
4 years	Diagnosed with juvenile idiopathic arthritis (JIA)	Managed with DMARDs and corticosteroids
17 years	Developed severe erosive arthritis of both hips with functional limitation	Underwent staged bilateral total hip arthroplasties (THA)
Post-THA period	Initial improvement in pain and mobility	Continued follow-up with satisfactory function
24 years	Presented with bilateral knee pain and bilateral hip pain	Diagnosed with erosive arthritis of both knees and aseptic loosening of bilateral hip prostheses
Stage 1 surgery	Combined reconstructive procedure	Revision right THA with acetabular bone grafting using an autologous graft from primary left TKA
Immediate postoperative period (Stage 1)	Correction of deformity and improved alignment	Mobilised full weight-bearing with a walker on postoperative day 1.
Stage 2 surgery	Second combined reconstructive procedure	Revision left THA with acetabular bone grafting using an autologous graft from primary right TKA
Immediate postoperative period (Stage 2)	Restoration of alignment and joint stability	Mobilised full weight-bearing with a walker on postoperative day 1
5-year follow-up	Long-term clinical outcome	Good functional recovery with no major hip or knee complaints; occasional pain in other joints due to progressive systemic disease

Functional Outcome

At the final 5-year follow-up, the patient demonstrated marked functional improvement with satisfactory pain relief and independent ambulation. Bilateral knee range of motion improved from preoperative values of 20°–100° on the right and 10°–100° on the left to 0°–110° bilaterally postoperatively. Functional assessment showed an improvement in the Harris Hip Score (HHS) from 42 preoperatively to 88 at the latest follow-up, while the Knee Society Score (KSS) improved from 38 to 85. Radiographic evaluation demonstrated stable implant fixation with no evidence of loosening, component migration, or periprosthetic osteolysis.

Discussion

Juvenile idiopathic arthritis (JIA) is the most common chronic rheumatologic disease in children and a leading cause of acquired disability. Despite major advances in medical therapy—particularly disease-modifying antirheumatic drugs (DMARDs) and biologic agents—which have significantly improved disease control and reduced the need for surgical

	Left total knee replacement (2016)	Right total knee replacement (2017)
Femoral component (cemented)	Posterior stabilised cemented size 2.5	Posterior stabilised cemented size 1.5
Tibial insert	Fixed bearing, stabilised size 2.5	Fixed bearing, stabilised size 2
Modular tibial tray (cemented)	Cemented modular tibial tray size 2.5	Cemented modular tibial tray size 2
Patella	Oval dome patella, 32 mm	Oval dome patella, 32 mm

Sequence of Events

intervention, a small subset of patients with severe or refractory disease still progress to end-stage joint destruction^{1,2}. In such cases, total joint arthroplasty (TJA) remains the definitive treatment for pain relief, restoration of function, and improvement in quality of life.

Arthroplasty in JIA is technically demanding due to multiple disease-related challenges, including early-onset deformities, small and osteopenic bone stock, soft-tissue contractures, and prolonged corticosteroid exposure⁵. Additional anatomical factors such as narrow femoral canals and acetabular dysplasia further complicate implant selection and fixation, particularly in patients with early disease onset or skeletal immaturity at the time of index surgery⁶.

In this present case, acetabular deficiency was managed using impaction bone grafting with an autologous morselised graft harvested during TKA, followed by implantation of a screw-augmented cementless acetabular component. This biological reconstruction technique is particularly advantageous in young patients, as it facilitates restoration of bone stock and promotes biological incorporation, thereby optimising conditions for

potential future revision procedures. Several reconstruction strategies have been described in the literature, each demonstrating variable long-term survivorship and functional outcomes⁷.

Although both total hip arthroplasty (THA) and total knee arthroplasty (TKA) in patients with juvenile idiopathic arthritis (JIA) have demonstrated favourable long-term outcomes, they are associated with higher revision rates compared with adult arthroplasty populations. This is primarily attributed to longer patient life expectancy, higher functional demands, and an increased risk of implant wear and loosening⁶. In the present case, the requirement for bilateral hip revision in early adulthood aligns with previous reports demonstrating a significant decline in implant survival beyond 10–15 years in JIA patients, particularly when primary arthroplasty is performed during adolescence⁴.

Revision arthroplasty in this population is technically more demanding than primary procedures. Contributing factors include compromised bone stock, prior implants, periprosthetic osteolysis, and an elevated risk of infection and instability, all of which may adversely affect outcomes⁸. Despite these challenges, the patient achieved satisfactory functional recovery following a staged and meticulously planned surgical strategy, highlighting the importance of multidisciplinary care and individualised rehabilitation in complex JIA cases.

This case underscores the significance of early diagnosis, aggressive medical management, and timely surgical intervention in JIA patients with progressive joint destruction. It further demonstrates that acceptable long-term functional outcomes can still be achieved even in cases requiring multiple joint arthroplasties and revision surgeries, provided that treatment is carefully planned and longitudinally followed.

Conclusion

This case emphasizes the importance of individualised treatment strategies in managing end-stage joint disease in JIA patients. It illustrates the rare and complex surgical course of a young adult with juvenile idiopathic arthritis who underwent staged bilateral total hip and knee arthroplasties followed by bilateral hip revision procedures. Despite substantial anatomical and technical challenges, satisfactory functional outcomes can be achieved through meticulous surgical planning, a multidisciplinary approach, and long-term follow-up.

References

- Beukelman T, Patkar NM, Saag KG, Tolleson-Rinehart S, Cron RQ, DeWitt EM, et al. 2011 American College of Rheumatology recommendations for the treatment of juvenile idiopathic arthritis: initiation and safety monitoring of therapeutic agents for the treatment of arthritis and systemic features. *Arthritis Care Res (Hoboken)*. 2011;63(4):465-82.
- Chhabra A, Isacson J, Weitzel E, Talmo CT. Surgical management of the juvenile idiopathic arthritis patient with multiple joint involvement. *Orthop Clin North Am*. 2014;45(4):537-48.
- Swarup I, Lee YY, Christoph EI, Mandl LA, Goodman SM, Figgie MP. Implant survival and patient-reported outcomes after total hip arthroplasty in young patients with juvenile idiopathic arthritis. *J Arthroplasty*. 2015;30(3):398-402.
- Ledbetter J, Salzmann GM, Brix M, Imhoff AB, Martinek V. Long-term outcome following knee replacement in patients with juvenile idiopathic arthritis. *Int Orthop*. 2010;34(8):1211-6.
- Marreiros S, Rego P, Sousa M, Saraiva J, Oliveira JM. Surgical treatment of juvenile idiopathic arthritis: a review. *J Child Orthop*. 2019;13(3):273-82.
- Goodman SB, Hwang K, Imrie S, et al. High complication rate in revision total hip arthroplasty in juvenile idiopathic arthritis. *Clin Orthop Relat Res*. 2014;472(2):637-44.
- Abolghasemian M, Tangsataporn S, Sternheim A, Backstein D, Safir O, Gross AE, et al. Combined trabecular metal acetabular shell and augment for acetabular revision with substantial bone loss: a mid-term review. *Bone Joint J*. 2013;95-B(2):166-72.
- Gharehdaghi M, Rahimi H, Eshraghi R, Mousavian A, Assadian M. Hip arthroplasty and its revision in a child: case report and literature review. *Arch Bone Jt Surg*. 2015;3(3):207-11.

ORIGINAL ARTICLE

Invisible Barriers To Female Participation In Orthopaedic Surgery Among Female Medical Students And House Officers in Pakistan: A Cross-Sectional Study

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1. Kantonsspital Baselland

Background/Aims: Women remain markedly underrepresented in orthopaedic surgery despite increasing female enrolment in medical schools. This study aimed to assess perceptions, interests, and perceived barriers influencing female medical students and house officers in Pakistan when considering orthopaedic surgery as a career, and to identify factors that may hinder or facilitate females.

Methods: A multicentre cross-sectional survey was conducted between March and June 2025 across public and private medical colleges and affiliated hospitals in Karachi, Pakistan. Fourth- and final-year medical students and house officers were recruited using convenience sampling. Data were collected using a validated, self-administered questionnaire assessing demographics, perceptions toward women in orthopaedics, subspecialty preferences, and perceived barriers. Descriptive statistics were calculated, and subgroup analyses were performed based on gender, training level, and orthopaedic exposure. Statistical analyses were conducted using SPSS and R, with a significance threshold of $p < 0.05$.

Results: A total of 368 participants were included (73% female; mean age 22.86 ± 2.44 years). Only 26% considered orthopaedic surgery for postgraduate training, with 20.1% of females (54/269) and 42.4% of males (42/99) of their respective subgroups expressing interest. Patient preference for male orthopaedic surgeons (78%), family and social commitments (75%), physical demands (67%), and gender discrimination (65%) were the most frequently reported barriers. Paediatric orthopaedics was perceived as the most suitable subspecialty for women. Participants with orthopaedic exposure demonstrated greater awareness of gender-based challenges.

Conclusion: Despite increasing awareness, substantial sociocultural and structural barriers continue to limit women's participation in orthopaedic surgery in Pakistan. Targeted mentorship, institutional support, and strategies to address gender bias are essential to promote a more inclusive orthopaedic workforce.

Keywords: Barriers, gender bias, orthopaedics, surgery, women, Pakistan

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Introduction

Women remain underrepresented in several professions, particularly in surgical specialties. Despite the growing demand for female surgeons and a broad consensus on the importance of developing a workforce that reflects the populations it serves; women continue to be inadequately represented in surgery (1). Currently, female surgeons constitute only 11% of consultant surgeons in the United Kingdom and Australia (2,3). A major concern is the disproportionately high attrition rate among women in surgical training programs, with many leaving before completion, despite evidence suggesting that women have strong potential to enter and succeed in these programs (1). Women pursuing surgical careers often encounter unfavorable work environments, compounded by personal and

family-related pressures, which contribute significantly to professional burnout (4).

Orthopaedic surgery is among the most male-dominated surgical specialties. According to reports, only 5% and 6% of active orthopaedic surgeons in the United States and England, respectively, are women (2,5). Although women represent approximately 50% of medical school graduates, only 15% of orthopaedic residents or fellows are female. This proportion is even lower in developing countries such as India and Pakistan. While female participation in surgical specialties has improved over time, growth within orthopaedics has been particularly slow when compared with other fields such as neurosurgery or thoracic surgery (6).

It is well recognised that female physicians interested in pursuing orthopaedic residency face multiple barriers

worldwide, with these challenges being more pronounced in Pakistan.

This study aims to address the barriers and difficulties faced by female doctors when considering orthopaedic surgery as a career choice to identify common challenges that hinder female doctors in Pakistan from choosing orthopaedic residency. Ultimately, this research seeks to propose targeted solutions, expand opportunities for women in orthopaedics, and establish a framework for future studies on gender disparities in surgical specialties.

Methods

Study Design

This was a cross-sectional survey conducted to assess perceptions and perceived barriers related to women pursuing orthopaedic surgery as a career.

Study Setting

The study was carried out at multiple public and private medical colleges and affiliated hospitals in Karachi, Pakistan, between March and June 2025.

Participants

The study population included fourth- and final-year undergraduate medical students and house officers (medical graduates undergoing clinical training). The response rate of this survey was 56%.

Inclusion criteria

Undergraduate Medical Students: Participants must be currently enrolled in an undergraduate medical education program.

Year of Study: First-, second-, third-, fourth-, and final-year undergraduate medical students, as well as house officers, were eligible. Third-year students were explicitly included as they had commenced clinical training and were enrolled at the participating institutions at the time of data collection; this is consistent with the participant data reported in Table 1 (third year n=97, 26.4%).

Exclusion criteria

Non-Medical Students: Individuals who are not currently enrolled in an undergraduate medical education program are excluded.

Postgraduate Students: Students who have already completed their undergraduate medical education and are pursuing postgraduate studies are excluded.

Incomplete Responses: Participants who do not fully complete the survey questionnaire will be excluded from the analysis.

Ethical Considerations

The study was conducted in accordance with the ethical guidelines formulated in the Declaration of Helsinki. Ethical

approval was obtained from the Ameen Medical and Dental Center (Reference No. ERC-CIRS-2023-603). Participation was voluntary, and informed consent was obtained from all participants prior to data collection. All questionnaire data were anonymised before analysis by removing identifying information. Confidentiality and anonymity of responses were maintained throughout the study.

Sampling and Recruitment

Non-probability convenience sampling was employed to select participating institutions and hospitals. Members of the research team visited selected public and private medical colleges and hospitals to recruit participants. Institutional permission was obtained prior to data collection. Eligible participants were approached in person, and informed consent was obtained before survey administration.

Data Collection Tool

Data were collected using a structured, self-administered questionnaire adapted from a previously published study conducted in Saudi Arabia (7). The questionnaire was selected following a comprehensive literature review and further evaluated by orthopaedic experts to ensure content validity and contextual relevance.

A pilot study was conducted to assess the reliability and validity of the questionnaire. The instrument demonstrated good internal consistency, with a Cronbach's alpha coefficient of 0.82.

Study Variables

The questionnaire consisted of 18 items divided into three sections:

- **Section A:** Collected demographic information, including age, gender, type of institution, and year of medical training.
- **Section B:** Assessed perceptions regarding women pursuing orthopaedic surgery as a career. This section included 13 items rated on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree." Participants were also asked to identify one orthopaedic subspecialty they perceived as most suitable for women and orthopaedic exposure of females. Orthopaedic exposure was defined as completion of a formal orthopaedic surgery rotation or course during undergraduate medical training, as self-reported by participants.
- **Section C:** Explored perceived barriers faced by women in orthopaedic surgery. Respondents indicated agreement or disagreement with nine predefined barriers.

Bias

Potential sources of bias included the use of convenience sampling and self-reported responses, which may introduce selection and response bias. Efforts were made to minimize these biases by recruiting participants from multiple institutions and ensuring anonymity of responses.

Statistical Analysis and Sample Size

The sample size of 217 was estimated using OpenEpi version 3.01, based on an anticipated frequency of 17% from a previous study (7), with a 5% margin of error and a 95% confidence interval. Data analysis was conducted using R (version 4.1.1) and SPSS software (Version 26). The mean and standard deviation (SD) were calculated for descriptive statistics of numeric variables, such as age. Categorical variables, like barriers and perceptions, were summarized using frequencies and percentages. The Shapiro-Wilk test was applied to assess the normality of the data. The distribution of categorical variables across different groups was compared using the Chi-square test. Likert scale responses for individual questions were analysed with one-sample tests to determine

statistical significance, while two-sample t-tests were used to compare Likert scale ratings between different groups and subgroups. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 368 participants completed the survey and included in the analysis. Among them, 73% were female and 27% male. The mean age of all participants was 22.86 ± 2.44 years. Almost 26.4% of the participants were in the third professional years, whereas 23.1% and 24.7% were in final year and house-officers respectively. Most of them (81.8%) were in their clinical years. All the detailed sociodemo-graphic characteristics are presented in Table 1.

Table.1. Sociodemographic of study participants

Participants	Total number of participants (N= 368)	Female n (% of females) (n = 269)	Male n (% of males) (n=99)	P- value
Age (in years)	22.86 $\pm$ 2.44 (Range:18-31)	22.5 $\pm$ 2.39	23.85 $\pm$ 2.32	<0.001**
Marital status	Marital status	Marital status	Marital status	Marital status
Single	327 (88.9%)	241 (89.6%)	86 (86.9%)	0.46
Married	41 (11.1%)	28 (10.4%)	13 (13.1%)	0.46
Designation/ academic year of medicine	Designation/ academic year of medicine	Designation/ academic year of medicine	Designation/ academic year of medicine	Designation/ academic year of medicine
First year	48 (13%)	45 (16.7%)	3 (3.0%)	<0.001**
Second year	19 (5.2%)	13 (4.8%)	6 (6.1%)	<0.001**
Third year	97 (26.4%)	79 (29.4%)	18 (18.2%)	<0.001**
Fourth year	28 (7.6%)	20 (7.4%)	8 (8.1%)	<0.001**
Final year	85 (23.1%)	64 (23.8%)	21 (21.2%)	<0.001**
House officers	91 (24.7)	48 (17.8%)	43 (43.4%)	<0.001**
Level of exposure	Level of exposure	Level of exposure	Level of exposure	Level of exposure
Pre-clinical years	67 (18.2%)	58 (21.6%)	9 (9.1%)	0.002*
Clinical years	301 (81.8)	211 (78.4%)	90 (90.9%)	0.002*
Institute	Institute	Institute	Institute	Institute
Public	208 (56.5%)	157 (58.4%)	51 (51.5%)	0.24
Private	160 (43.5%)	112 (41.6%)	48 (48.5%)	0.24
Taken orthopaedic surgery course				0.24
Yes	182 (49.5%)	117 (43.5%)	65 (65.7%)	<0.001**
No	186 (50.5%)	152 (56.5%)	34 (34.3%)	<0.001**
Planning to pursue postgraduate training in orthopaedics				<0.001**
Yes	96 (26.1%)	54 (20.1%)	42 (42.4%)	<0.001**
No	196 (53.3%)	156 (58.0%)	39 (39.4%)	<0.001**
Do not know	76 (20.7%)	58 (21.6%)	18 (18.2%)	<0.001**

A limited number of participants (26%) considered orthopaedic surgery for postgraduate training, while 20.7% were unsure about choosing orthopaedics. Further subgroup analysis

showed that 54 females (20.1% of female participants) and 42 males (42.4% of male participants) were interested in pursuing orthopaedics as a . However, 49.5% of the total participants had

exposure of orthopaedics. The subgroup analysis revealed that a higher number of males (65.7%) had previous exposure of orthopaedics. Subgroup responses by level of progression in professional years showed an increase trend from 1- 4th

professional years. Only 18.7% of 1st years participants were interested in orthopaedics, which was increased up to 35.1% in graduated house officers (Figure.1).

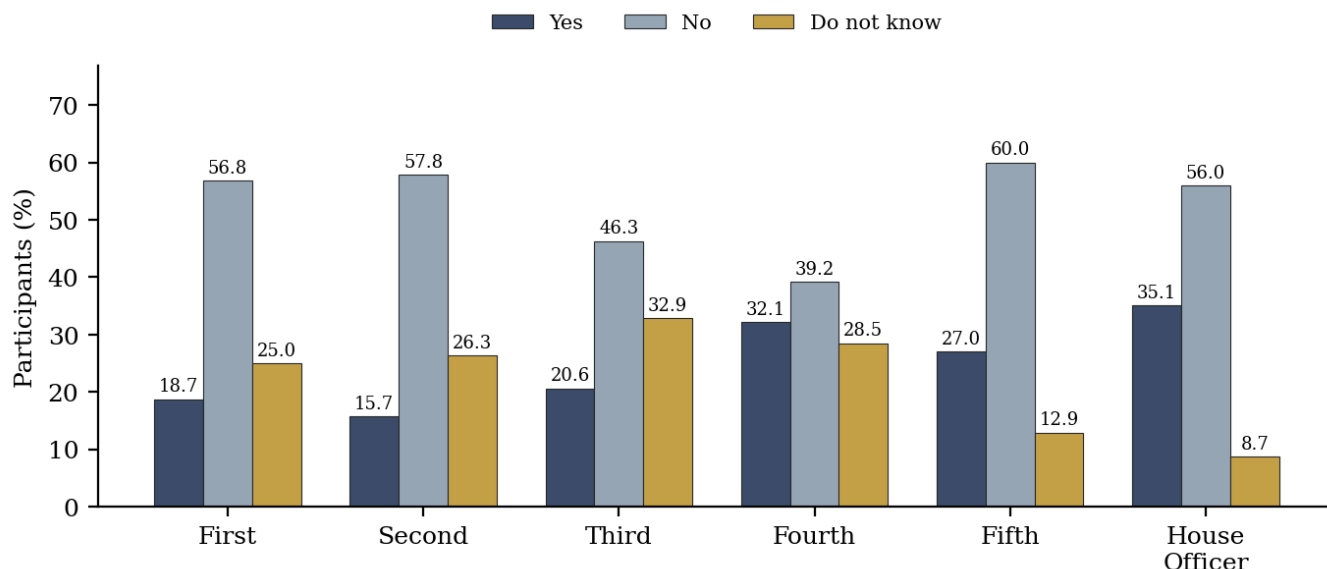


Figure 1. Level of progression in professional years and interest in orthopaedic surgery.

Sub-specialty in orthopaedics preferred for women

Almost 35 participants agreed that all specialties are perceived as suitable for women. However, 44.6% of female participants and 33.3% of male participants suggested paediatric orthopaedics as the most suitable specialty for women followed by sports medicine, orthopaedic oncology and hands and upper extremity. Deformity and shoulder surgery were the least chosen specialties for women. Furthermore, participants who

had not taken an orthopaedic surgery course had a higher preference for paediatric orthopaedics compared to those who had (48.4% vs 34.6%). However, participants who took orthopaedic course had high preferences for sports medicine, orthopaedic oncology, and hands and upper extremity than those who did not. Among all of them, 12.1% of participants who had taken an orthopaedic course suggested that women can choose any specialty. All detailed responses about sub-specialty preferences of women are presented in Table 2.

Table.2. Subgroup analysis of chosen subspecialties perceived as most suitable for women in orthopaedic surgery according to gender and prior orthopaedic exposure

Specialty	Number of participants	Number of participants	Taken orthopaedics surgery course	Taken orthopaedics surgery course
	Female (%) n=269	Male (%) n=99	Yes n=182	No n=186
Pediatric orthopedics (n=153)	120 (44.6)	33 (33.3)	63 (34.6)	90 (48.4)
Sports medicine (n=24)	14 (5.2)	10 (10.1)	13 (7.1)	11 (5.9)
Trauma (n=16)	11 (4.1)	5 (5.1)	10 (5.5)	6 (3.2)
Spine surgery (n=15)	13 (4.8)	2 (2.0)	8 (4.4)	7 (3.8)
Shoulder (n=7)	6 (2.2)	1 (1.0)	2 (1.1)	5 (2.7)
Deformity (n=3)	1 (0.4)	2 (2.0)	2 (1.1)	1 (0.5)
Arthroscopy (n=11)	5 (1.9)	6 (6.1)	7 (3.8)	4 (2.2)
Foot and ankle surgery (n=13)	9 (3.3)	4 (4.0)	7 (3.8)	6 (3.2)
Hand and upper extremity (n=23)	20 (7.4)	3 (3.0)	12 (6.6)	11 (5.9)
Orthopedics oncology (n=24)	19 (7.1)	5 (5.1)	15 (8.2)	9 (4.8)
Do not know (n=44)	26 (9.7)	18 (18.2)	23 (12.6)	21 (11.3)

All of them (n=35)	25 (9.3)	10 (10.1)	22 (12.1)	13 (7.0)
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Perception of participants about barriers for women in orthopaedics

The overall response of all participants revealed that there are certain barriers that prevent women to pursue orthopaedic surgery as a career. Overall, 78% of the participants considered patients' preference of male orthopaedic surgeon as the leading barrier for women. Similarly, 75% of the participant chose family and social commitment as barrier for women in orthopaedics followed by physical strength and body build (67%), gender discrimination (65%), on- call duties and covering trauma and emergency (63%), stress and burn out (59%), long working hours and workload (59%) and radiation exposure in orthopaedics (58%). However, 37% of the total participants believe that there are any barriers for women in orthopaedic surgery. The gender-based sub grouping between

female and male revealed preference of male orthopaedic surgeons (78.1% vs 78.8%, $P=0.88$), family and social commitments (75.8% vs 73.7%, $P=0.67$) and physical strength and body build (65.1% vs 71.7%, $P=0.22$) as the most commonly reported barriers in both sub-groups; however, none of these gender differences reached statistical significance (all $p > 0.05$).

The group analysis of participants who had taken an orthopaedic course perceived patients' preference of male orthopaedic surgeon (80.2%), gender discrimination (75.3%) and family and social commitments (73.6%) as the top barriers for women. There was statistically significant difference observed in barriers like gender discrimination and on call duties and covering trauma and emergencies between participants who took orthopaedic course and who did not ($P < 0.05$). Details are presented in Table 3.

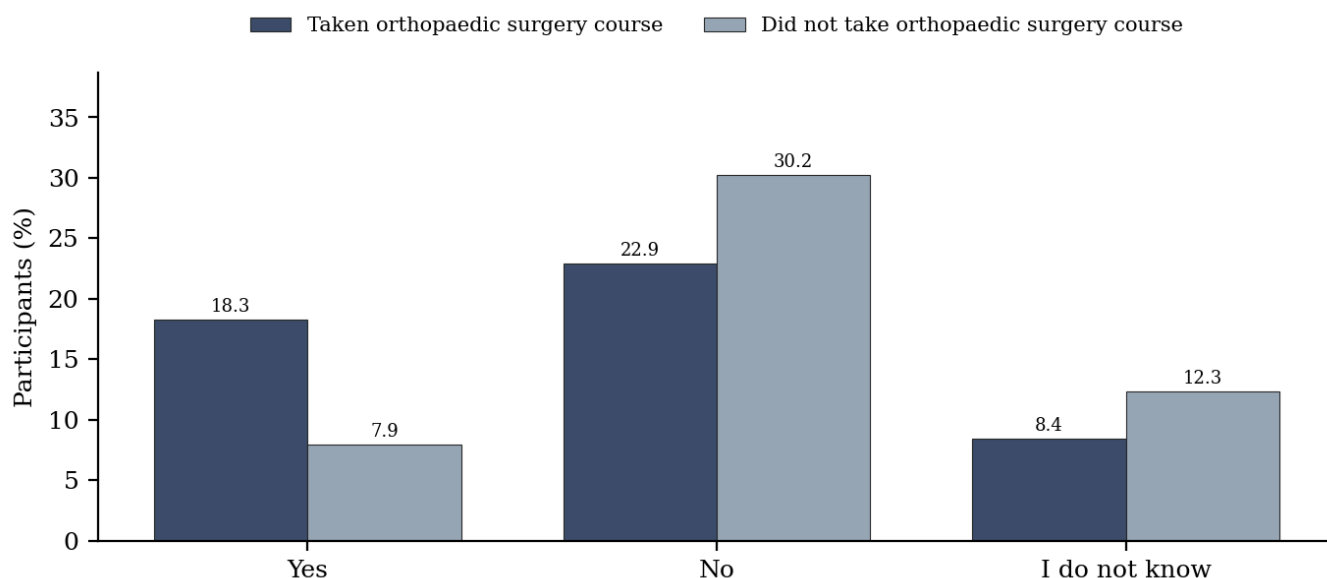


Figure 2. Exposure of orthopaedic surgery and intentions to pursue postgraduate training in orthopaedics.

Table 3. Subgroup analysis of perceived barriers to female participation in orthopaedic surgery according to gender and prior orthopaedic course exposure

Barriers for females in orthopaedic surgery (N)	Number of participants	Number of participants	P-value	Taken orthopaedic surgery course	Taken orthopaedic surgery course	P-value
Barriers for females in orthopaedic surgery (N)	Female N (%) n=269	Male N (%) n=99	P-value	Yes N (%) n=182	No N (%) n=186	P-value
Gender discrimination (n=239)	174 (64.7)	65 (65.7)	0.86	137 (75.3)	102 (54.8)	<0.001**
I do not believe that there are any barriers (n=137)	92 (34.2)	45 (45.5)	0.04	53 (29.1)	84 (45.2)	0.001**
On-call duties and covering trauma and emergencies (n=232)	170 (63.2)	62 (62.6)	0.92	105 (57.7)	127 (68.3)	0.03*
Stress and burn-out (n=216)	156 (58.0)	60 (60.6)	0.65	105 (57.7)	111 (59.7)	0.69
The family and social commitments (n=277)	204 (75.8)	73 (73.7)	0.67	134 (73.6)	143 (76.9)	0.46

The long working hours and heavy workload (n=216)	157 (58.4)	59 (59.6)	0.83	99 (54.4)	117 (62.9)	0.09
The patients' preference of male orthopaedic surgeon (n=288)	210 (78.1)	78 (78.8)	0.88	146 (80.2)	142 (76.3)	0.36
The physical strength and body build (n=246)	175 (65.1)	71 (71.7)	0.22	121 (66.5)	125 (67.2)	0.88
The radiation exposure in orthopaedics (n=214)	165 (61.3)	49 (49.5)	0.03	104 (57.1)	110 (59.1)	0.74

Note: Values are presented as number (percentage). Percentages were calculated within each subgroup category. The table demonstrates the association of perceived barriers for females in orthopaedic surgery according to participant gender and previous exposure to an orthopaedic surgery course. Comparisons between groups were performed using the Chi-square test. A p-value of <0.05 was considered statistically significant. Participants were allowed to select more than one barrier; therefore, cumulative percentages may exceed 100%.

Gender differences in perception of orthopaedic surgery suitability

The perceptions about barriers did not vary significantly between male and female participants except perception about women are as suitable for orthopaedic surgery, orthopaedic surgeons possess greater surgical skills, stress and burn out and

orthopaedic surgery is not a suitable for women as shown in Table 4. The female had significantly higher agreement about suitability of orthopaedics for women. However, male participants showed significant agreement about orthopaedic surgeons possess greater surgical skills, stress and burn out and orthopaedic surgery is not a suitable for women ($P < 0.05$) (Table 4).

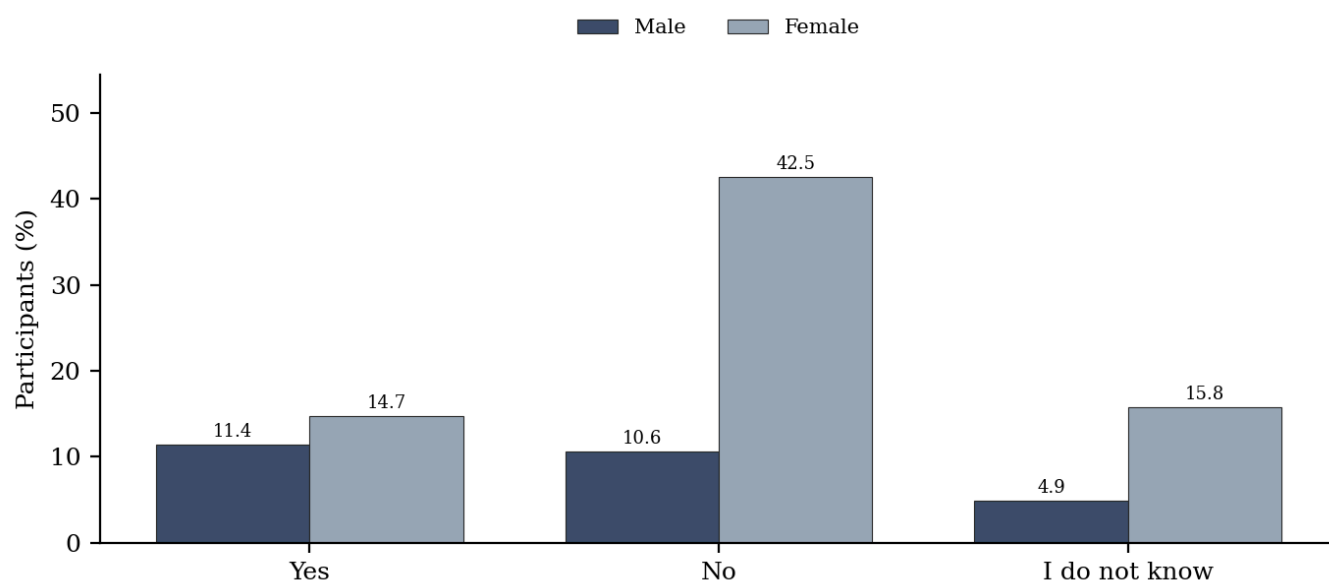


Figure 3. Gender-wise distribution of respondents' intentions to pursue postgraduate training in orthopaedics.

Table 4. Perception of participants about barriers for women in orthopaedics and its association with gender

Questions	Overall score	Perception differences in male and female	Perception differences in male and female	Perception differences in male and female
Questions	Mean Likert score ^b	Female	Male	P-value
1 Is gender diversity important in the field of orthopaedic surgery?	2.62	2.60	2.68	0.81
2 Do you believe that women are as suitable for orthopaedic surgery? ^a	2.80	2.89	2.54	0.01**
3 I think that male orthopaedic surgeons are often perceived as more trustworthy by patients compared to their female counterparts	2.63	2.57	2.77	0.22
4 I think that the potential risk of radiation exposure in orthopaedics could act as an obstacle for women pursuing a career in orthopaedic surgery	2.21	2.19	2.26	0.63
5 I think that the responsibilities of being on-call, particularly for trauma and emergencies in orthopaedics, might present a challenge for women in the field of orthopaedic surgery	2.18	2.14	2.29	0.33

	effectiveness of the profession and the cohesion of the orthopaedic surgery community	2.83	2.86	2.75	0.66
7	I think that male orthopaedic surgeons possess greater surgical skills compared to their female counterparts in orthopaedics	1.72	1.56	2.15	<0.001**
8	I believe that familial and societal responsibilities can present an obstacle for women pursuing a career in orthopaedic surgery	2.60	2.58	2.63	0.77
9	I think that the physical strength and body composition required for practicing orthopaedic surgery can hinder women's participation in the field	2.38	2.32	2.56	0.06
10	I think that the demanding work hours and substantial workload can pose a challenge for women who wish to practice orthopaedic surgery	2.28	2.25	2.38	0.35
11	I believe that the stress and potential burnout experienced in the field of orthopaedics can serve as obstacles for women pursuing a career in orthopaedic surgery	2.10	2.03	2.30	0.05*
12	I hold the belief that orthopaedic surgery is not a suitable or fitting career choice for women	1.34	1.20	1.73	<0.001**

Note.^a This item represents a negation response option (i.e., denial of any barrier), not a barrier per se, and should be interpreted separately from the barrier items above.^b **Likert scale:** 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. Lower mean scores reflect greater disagreement. Bold p-values indicate statistically significant differences ($p < 0.05$) between female and male subgroups, tested using two-sample t-tests. *P-value < 0.05 was considered as significant

Impact of level of exposure on perception

Overall, the level of exposure in term of clinical years did not statistically significantly impact the perception of participants, except importance of gender diversity and preference of male orthopaedic surgeons by patients ($P < 0.05$). The female

participants in their clinical years had significant higher agreement about importance of gender diversity, preference of male orthopaedic surgeons by patients and diverse gender representation. The level of exposure was not significantly impacting the perception among male participants. All details are mentioned in Table 5.

Table.5. Impact of level of exposure on perception

Question	Overall Likert score	Overall Likert score	Overall Likert score	Female students Likert score	Female students Likert score	Female students Likert score	Male student Likert score	Male student Likert score	Male student Likert score
Question	Pre-clinical year (N=115) Mean	Clinical year (N=253) Mean	P- value	Pre-clinical year (N=96) Mean	Clinical year (N=173) Mean	P- value	Pre-clinical year (N=19) Mean	Clinical year (N=80) Mean	P-value
Is gender diversity important in the field of orthopaedic surgery?	2.34	2.75	0.01	2.21	2.82	0.001	3	2.60	0.15
Do you believe that women are as suitable for orthopaedic surgery?	2.91	2.75	0.13	3.01	2.83	0.13	2.42	2.57	0.71
I think that male orthopaedic surgeons are often perceived as more trustworthy by patients compared to their female counterparts	2.37	2.74	0.01	2.30	2.72	0.01	2.73	2.78	0.80
I think that the potential risk of radiation exposure in orthopaedics could act as an obstacle for women pursuing a career in orthopaedic surgery	2.20	2.22	0.92	2.12	2.23	0.48	2.57	2.18	0.19
I think that the responsibilities of being on-call, particularly for trauma and emergencies in orthopaedics, might present a challenge for women in the field of orthopaedic surgery	2.33	2.12	0.19	2.32	2.05	0.12	2.36	2.27	0.75
I think that having a diverse gender representation within the field of orthopaedic surgery is a crucial element that enhances both the effectiveness of the profession and the cohesion of the orthopaedic surgery community	2.71	2.88	0.13	2.64	2.98	0.01	3.05	2.68	0.15
I think that male orthopaedic surgeons possess greater surgical skills compared to their female counterparts in orthopaedics	1.63	1.76	0.41	1.57	1.56	0.96	1.94	2.20	0.49

I believe that familial and societal responsibilities can present an obstacle for women pursuing a career in orthopaedic surgery	2.66	2.57	0.44	2.61	2.57	0.75	2.89	2.57	0.22
I think that the physical strength and body composition required for practicing orthopaedic surgery can hinder women's participation in the field	2.26	2.44	0.26	2.25	2.36	0.49	2.36	2.61	0.58
I think that the demanding work hours and substantial workload can pose a challenge for women who wish to practice orthopaedic surgery	2.33	2.26	0.63	2.32	2.21	0.44	2.36	2.38	0.93
I believe that the stress and potential burnout experienced in the field of orthopaedics can serve as obstacles for women pursuing a career in orthopaedic surgery	2.12	2.09	0.89	2.09	2	0.55	2.26	2.31	0.93
I hold the belief that orthopaedic surgery is not a suitable or fitting career choice for women (chose any one option)	1.22	1.39	0.24	1.10	1.25	0.35	1.84	1.71	0.65

reports mean Likert scores stratified by clinical exposure level (pre-clinical vs clinical years) for the overall sample, and separately for female and male subgroups. Likert scale: 1 = Strongly Disagree, 5 = Strongly Agree. Bold p-values indicate $p < 0.05$ (two-sample t-tests).

Discussion

This cross-sectional study provides important insights into perceptions, interests, and perceived barriers related to women pursuing orthopaedic surgery among medical students and house officers in Pakistan. Despite an increasing global emphasis on gender equity in medicine, our findings highlight that orthopaedic surgery continues to be perceived as a challenging and less attractive career option for women, largely due to sociocultural, professional, and structural barriers.

One of the most notable findings was that only 26% of participants reported considering orthopaedic surgery for postgraduate training, and when broken down by gender, males showed proportionally higher interest within their subgroup (42.4% of males vs 20.1% of females). This is a particularly noteworthy finding: despite 49.5% of all participants reporting prior orthopaedic exposure, interest in the specialty remained consistently low and did not meaningfully differ between exposed and unexposed groups. This suggests that the quality, context, and culture of orthopaedic training environments — rather than mere exposure — may be the critical determinant of career interest. Negative experiences during rotations, such as witnessing gender bias, physically demanding working conditions, or a lack of female mentors, may actively discourage female trainees regardless of the quantity of exposure received. Future interventions should therefore focus not only on increasing access to orthopaedic rotations but on ensuring that those experiences are structured, supportive, and inclusive of women. This aligns with global trends demonstrating persistently low female representation in orthopaedics despite women comprising approximately half of medical graduates worldwide^{2,5,6}. However, the upward trend in interest among house officers compared to earlier-year students indicates that prolonged clinical interaction and mentorship may gradually shift perceptions, an important consideration for curriculum developers and policymakers.

In line with the global literature, the perceived barriers identified in this study were multi-dimensional. Patient preference for male orthopaedic surgeons emerged as the most prominent barrier (78%), underscoring a deeply rooted societal

bias that extends beyond the healthcare system. Similar concerns have been reported in other countries, where cultural expectations and gender norms shape patients' comfort levels with surgeons of different genders. In Pakistan, where gendered social norms strongly influence professional roles, this barrier may be particularly amplified.

Interestingly, although nearly half of participants reported prior exposure to orthopaedics, only a small fraction of those exposed expressed interest in pursuing it as a career. This contrasts with some studies from high-income countries where increased exposure has been associated with greater interest in orthopaedic careers^{8,9}. In the Pakistani context, exposure may instead reinforce negative perceptions related to workload, physical demands, and gender bias, highlighting qualitative differences in training environments across settings.

Participants predominantly perceived paediatric orthopaedics as the most suitable subspecialty for women, followed by sports medicine and upper extremity surgery. This pattern reflects gender stereotyping observed in previous studies, where women are often steered toward subspecialties perceived as less physically demanding or more “family-friendly”^{10,11}. The finding that participants who completed orthopaedic rotations were more likely to endorse a wider range of subspecialties including oncology and sports medicine suggests that structured exposure may help challenge such stereotypes, although its impact remains limited.

Consistent with international literature, patient preference for male orthopaedic surgeons emerged as the most commonly perceived barrier, followed by family and social commitments, physical strength requirements, and gender discrimination^{7,12–14}. These findings underscore the persistence of both external (societal expectations, patient bias) and internal (self-perception, work–life balance concerns) deterrents to female participation in orthopaedics.

Male and female respondents differed in their perceptions of certain barriers. Female participants were more likely to affirm the suitability of women for orthopaedic surgery ($p=0.01$), whereas male participants more frequently endorsed views related to higher stress, burnout ($p=0.05$, borderline), and

unsuitability of orthopaedics for women ($p < 0.001$). Caution is warranted in interpreting the stress/burnout difference, as it only reached borderline significance. Similar gender-based perception gaps have been reported elsewhere and may reflect unconscious bias and deeply ingrained professional norms^{13,15}.

Participants who had completed an orthopaedic course demonstrated greater awareness of gender discrimination and on-call demands as barriers, with statistically significant differences compared to those without exposure. This suggests that direct experience may uncover systemic issues within orthopaedic training environments, reinforcing the need for structural reforms rather than solely focusing on recruitment. Our findings are broadly consistent with studies from Saudi Arabia, India, and Western countries, which report low interest among female trainees and identify similar barriers, including workload intensity, gender bias, and lack of mentorship^{7,10,12}. However, the magnitude of perceived barriers particularly sociocultural and family-related constraints appears more pronounced in Pakistan, reflecting contextual differences in societal expectations and healthcare systems.

To our knowledge, this is among the few studies from Pakistan that comprehensively evaluates perceptions, subspecialty preferences, and barriers related to women in orthopaedic surgery using a validated instrument. The inclusion of both undergraduate students and house officers provides a developmental perspective on career decision-making. Furthermore, subgroup analyses based on gender, level of training, and orthopaedic exposure offer nuanced insights that can inform targeted interventions.

A key strength of this study is its focus on an underexplored yet critically important issue within Pakistan's surgical workforce. By surveying medical students and house officers from multiple public and private institutions, the study captures the perspectives of trainees at different stages of their medical education. This enhances the diversity and representativeness of the sample. The strengths of this study include its multicentre design, relatively large sample size, inclusion of both genders, and use of a validated questionnaire with good internal consistency.

However, several limitations must be acknowledged. The use of convenience sampling may limit generalisability, and the predominance of female respondents may introduce response bias. Specifically, the sample comprised 73% female participants, which may skew perceptions of barriers and subspecialty preferences toward those more salient to women; male perspectives are correspondingly underrepresented and findings should not be generalized equally to both groups. Self-reported perceptions are subject to social desirability bias, and the cross-sectional design precludes causal inferences. Additionally, qualitative data was not collected, limiting deeper exploration of participants' lived experiences. The

questionnaire had a good Cronbach's alpha that represented good internal consistency reliability, however, test re-test reliability was not tested and reported. Furthermore, confidence intervals were not reported alongside p-values for the main group comparisons, which limits readers' ability to assess the precision and clinical magnitude of effect estimates; future studies should routinely report 95% CIs.

Addressing gender disparities in orthopaedic surgery requires multifaceted strategies. These include early mentorship programs, visible female role models, flexible training pathways, institutional policies supporting work-life balance, and initiatives to counter patient and professional gender bias. Future research should incorporate qualitative methodologies to explore underlying attitudes in greater depth and longitudinal designs to assess how perceptions evolve over time. National-level studies and intervention-based research are also needed to evaluate the effectiveness of targeted programs aimed at improving female recruitment and retention in orthopaedics.

In conclusion, this study highlights that although awareness and exposure to orthopaedics are increasing among female medical trainees in Pakistan, substantial cultural, structural, and perception-based barriers continue to limit women's participation in the specialty. Addressing these barriers requires coordinated efforts across medical schools, hospitals, professional societies, and policymakers. Having supportive training environments and promoting gender equity, Pakistan can build a more diverse orthopaedic workforce that better reflects and serves its population.

References

- Liang R, Dornan T, Nestel D. Why do women leave surgical training? A qualitative and feminist study. *The Lancet*. 2019 Feb 9;393(10171):541-9.
- Royal College of Surgeons, England. <https://www.rcseng.ac.uk/careers-in-surgery/women-in-surgery/statistics/> (accessed Aug 25, 2018)
- Royal Australasian College of Surgeons. Surgical Workforce 2014 Census Report. http://www.surgeons.org/media/21893722/2015-06-05_rpt_-2014_census.pdf (accessed Feb 27, 2018)
- Attia AC, Brown SM, Ladd AL, Mulcahey MK. Representation of Male and Female Orthopedic Surgeons in Specialty Societies. *Orthopedics*. 2021 Sep-Oct;44(5):289-292. doi: 10.3928/01477447-20210819-04. Epub 2021 Sep 1. PMID: 34590954
- Accreditation Council for Graduate Medical Education. ACGME Data Resource Book Academic Year 2018-2019. Department of Applications and Data Analysis; 2019. Available at: <https://www.acgme.org/About-Us/Publications-andResources/Graduate-Medical-Education-Data-Resource-Book>. Accessed November 16, 2019
- Whitaker J, Hartley B, Zamora R, Duvall D, Wolf V. Residency selection preferences and orthopaedic career perceptions: a notable mismatch. *Clinical Orthopaedics and Related Research*. 2020 Jul 1;478(7):1515-25
- Alomar AZ, Almonaie S, Nagshabandi KN, AlGhufaili D, Alomar M. Representation of women in orthopaedic surgery: perception of barriers among undergraduate medical students in Saudi Arabia. *Journal of Orthopaedic Surgery and Research*. 2023 Jan 7;18(1):19.
- O'Connor MI. Medical school experiences shape women students' interest in orthopaedic surgery. *Clin Orthop Relat Res*. 2016;474(9):1967-1972

Rohde RS, Wolf JM, Adams JE. Where are the women in orthopaedic surgery? *Clin Orthop Relat Res.* 2016;474(9):1950–1956.

Van Heest AE, Fishman F, Agel J. A 5-Year Update on the Uneven Distribution of Women in Orthopaedic Surgery Residency Training Programs in the United States. *J Bone Joint Surg Am.* 2016 Aug 3;98(15):e64. doi: 10.2106/JBJS.15.00962. PMID: 27489326.

Hariri S, York SC, O'Connor MI, Parsley BS, McCarthy JC. Career plans of current orthopaedic residents with a focus on sex-based differences. *J Bone Joint Surg Am.* 2011;93(5):e16.

Trinh LN, O'Rourke E, Mulcahey MK. Factors Influencing Female Medical Students' Decision to Pursue Surgical Specialties: A Systematic Review. *J*

Surg Educ. 2021 May-Jun;78(3):836-849. doi:

10.1016/j.jsurg.2020.08.050. Epub 2020 Sep 12. PMID: 32933885.

Burgess DJ, Joseph A, van Ryn M, Carnes M. Does stereotype threat affect women in academic medicine? *Acad Med.* 2012;87(4):506–512.

Seemann NM, Webster F, Holden HA, Moulton CA, Baxter N, Desjardins C, Cil T. Women in academic surgery: why is the playing field still not level? *Am J Surg.* 2016 Feb;211(2):343-9. doi: 10.1016/j.amjsurg.2015.08.036. Epub 2015 Nov 17. PMID: 26723836.

Stephens EH, Heisler CA, Temkin SM, Miller P. The current status of women in surgery: how to affect the future. *JAMA Surg.* 2020;155(9):876–885.

REVIEW

Dermatofibrosarcoma protuberans (DFSP). A narrative review of the literature and current guidelines for its management

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Dermatofibrosarcoma protuberans (DFSP) is a slow growing low grade malignant tumour with a high rate of local recurrence and lower rate of metastasis and effecting patients between the 3rd and 5th decade. It accounts for less than 1% of all soft tissue sarcomas and can equally involve the trunk and extremities. It usually presents in the subcutaneous tissue but can grow deeper if increases in size. Diagnosis is usually with biopsy and is confirmed with its typical histological appearance of uniform spindle cells arranged in a storiform or honeycomb pattern with minimal cytologic atypia and low mitotic activity and shows diffuse positivity for CD34 on immunohistochemistry. The standard treatment after staging involves wide excision to achieve clear margins hence avoiding risk of local recurrence, which may be reduced with the use of adjuvant radiotherapy (RT), however, its use should be considered after discussion in multidisciplinary team meetings for select cases. The use of RT is more pronounced in larger/ unresectable or metastatic disease cases along with the use of Tyrosine kinase inhibitors (TKI) which has shown very promising results, particularly with Imatinib in cases with PDGFB mutations. The reported overall survival at 10 years following appropriate surgical treatment with localized DFSP is around 90%. The aim of this current review is to highlight the clinical features of DFSP, its surgical management and adjuvant treatments along with the current management guidelines.

Keywords: Dermatofibrosarcoma protuberans, DFSP, Sarcoma, wide local excision, Tyrosine kinase inhibitors.

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Introduction

This slow growing low to intermediate grade malignant cutaneous soft tissue sarcoma was named as DFSP in 1925 by the renowned German dermatologist, Dr. Eric Hoffman¹. It usually effects middle aged patients, but has been reported in all age groups, and can involve any part of the body but mostly extremities and the trunk and presents less than 1% of all soft tissue sarcomas. They effect men more than women and is more common in the darker skin population than white races^{2,3}. Its exact incidence in Pakistan, however, cannot be reported because of the lack of any national tumour registries or referral centres⁴. They can vary in size from sub centimeter to larger or recurrent lesions of varying sizes. They are usually painless lesions and can eventually cause symptoms depending on its location and size due to compression of surrounding structures. Radiological diagnosis is usually by magnetic resonance imaging (MRI) and for complete staging a computerized tomography scan (CT scan) or 18F-

fluorodeoxyglucose-positron emission tomography/computed tomography (18F-FDG PET/CT) is required^{5,6}. A punch or excision biopsy is required to confirm the histological diagnosis which shows spindle cell neoplasms in a characteristic honeycomb pattern with abundant myxoid stroma and increased cellularity and CD34 positivity on immunohistochemical staining⁷.

Standard treatment involves surgery in the form of wide local excision with attainment of R0 margins or Moh's micrographic surgery in certain cases⁷. In larger or recurrent lesions, wide local excision followed by soft tissue coverage with pedicled or free flaps is required (Figure 3A-E). In some advance cases involving the limbs, ablative surgery may be required where absolute indications for such are met⁸. They carry a very high risk of local recurrence (10-60%) and in certain cases, they can metastasize to various organs including lungs, lymph nodes, brain and adjacent structures (1-7.4%)^{9,10}. In cases of inoperable or multiply recurrent lesions, adjuvant treatments

such radiotherapy and more recently targeted therapy in the form of Tyrosine kinase inhibitors is utilized¹¹. The reported overall survivorship in non-metastatic disease is around 75% at 10 years¹².

This review article will highlight the clinical features, diagnostic work up along with surgical and medical management in keeping with the current available best clinical practices for this often misdiagnosed and difficult to treat soft tissue sarcoma.

Clinical Features

DFSP originates from the dermis and has a tendency to invade the surrounding tissues and manifests itself in the form of a solitary or a multi lobulated, painless, slow growing cutaneous lesion^{13,14}. They can present in various pathologic forms including a nodule, plaque, atrophic plaque or large lump and can be congenital or acquired, with acquired variety due to genetic mutations in chromosomes 17 & 22¹⁴. These lesions can be of varying sizes and can at times be static for years which can lead to delayed presentation. The superficial lesions can be red-brown to bluish nodular in appearance and may exhibit irregular margins¹⁵. Due to these varied presentations, they can often be missed, mis-treated surgically leading to positive margins excision or missed diagnosis delaying further treatment and compromising outcomes¹⁶. Most DFSP's present in the truncal lesion, followed by extremities and head neck^{17,18}.

Clinical examination along with the lesion must always include the local lymph nodes for involvement to document the staging of the disease. The lack of clinical awareness due to these varied presentations and rare occurrence of DFSP along with the absence of referral centers are also contributory causes of these guarded outcomes.

Diagnosis

Radiology & Staging

Ultrasound can be utilized as a screening investigation, which demonstrates a predominantly hypoechoic lesion with tail like projections seen in the periphery (Figure 1). Mild increased signal on Doppler imaging can be seen in some cases. Ultrasound is also helpful in performing image guided biopsy particularly in cases where the lesion is overlying or close to important structures.

MRI is the investigation of choice both for primary and recurrent lesions demonstrating the size, actual depth of the lesion and its association with important structures such as the neurovascular bundle and tendons. These are low to isointense to skeletal muscle on T1 and demonstrate high signal on fluid sensitive sequences. Peripheral appendage like extensions along the dermis can be seen on MRI. These demonstrate

homogenous or heterogeneous enhancement on post contrast images^{5,19}.

CT scans and 18F-FDG PET/CT can be used for staging of the disease along with evaluation of local lymph nodes, whereas the later can also be used to evaluate treatment response^{12,20}.

Biopsy & Histology

Diagnosis of DFSP requires a well performed biopsy in the form of a punch biopsy for smaller lesions and a trucut biopsy or excision biopsy for larger lesions. In cases of a recurrent or larger lesion in close proximity to important neurovascular structures, an ultrasound guided biopsy is advised. On gross microscopy, DFSP are dermal based spindle cell neoplasms which shows diffuse infiltration into the subcutaneous tissue and extension towards the overlying dermis. These tumor cells infiltrate the subcutaneous adipose tissue in a characteristic honeycomb or storiform pattern showing hypo cellular spindle cells embedded within abundant myxoid stroma and characterized by increased cellularity and intersecting fascicles arranged in a herringbone architecture (Figure 2A-D).

Immunohistochemistry panels will show strong and diffuse expression of CD34 which may be reduced or even lost in almost half the cases of DFSP with fibrosarcomatous transformation. CD 34 positivity is also noted in certain other soft tissue lesions including fibromyxomas, fibromas and Kaposi's sarcoma. DFSP will typically show negative expression for S100 and Factor XIIIa^{21,22}. DFSP's also demonstrate a morphological heterogeneity with multiple variants including myxoid, giant cell, sclerotic, pigmented and fibrosarcoma components. Except for fibrosarcoma, these variants do not have any significant clinical variations¹⁷.

Treatment

DFSP should be treated in a local referral center in a tumour board setting with all expertise on board wherein the best treatment can be offered keeping in view the recent most guidelines^{23,24}. This multidisciplinary approach has led to improved oncological and reconstructive outcomes leading to reduced risk of local recurrence and improving functional. However, treatment should be commenced only after complete local and systemic staging of the disease.

Surgery

Complete and wide surgical excision of DFSP remains the mainstay of treatment and adequate surgical excision guarantees lower risk of local recurrence and subsequent systemic disease. Various surgical techniques have been reported in the literature for treatment of DFSP, but Mohs micrographic surgery (MMS) is still considered to be the ideal form. This technique, involves microscopic examination of each removed tissue for cancer cells with main difference from conventional surgical excision being the different pathological processing of the lesion but offering equal results to it with

minimal surgical morbidity²⁵. This, however, can be tedious and not available in all centers. With conventional surgery, aim should be to achieve Ro margins with a minimum of 2 cm circumferentially, where possible¹⁵. In order to reduce the risk of positive margins, fresh frozen specimen sectioning should be utilized where available. This is more important because of the finger like projections of DFSP in surrounding tissues. The choice of surgical procedure along with expertise, is usually dependent upon the size and location of tumour, where a DFSP of small size and in the head and neck region would be best dealt with MMS.

In a study by Snow et al., they reported a 7% risk of local recurrence at 5 years after MMS²⁶. They suggested that adequate local control be provided by a further repeat MMS if required. The efficacy of MMS and wide excision in achieving clear margins has been reported to be equal in various studies, however, Meguerditchian et al., have reported increased incidence of positive margins with conventional surgery^{27,28}. It is worth noting, that all the studies propose a long term follow up, usually longer than or up to 10 years, due to reported incidence of delayed local recurrence.

Radiotherapy

The role of radiotherapy is well established in the management of DFSP and has been used and described in various studies both in the neoadjuvant and adjuvant settings. Various studies have reported a lower risk of local recurrence with its use. In a systematic review by Chen et al., the authors proposed that adjuvant radiotherapy may be considered for all patients even with a negative margin to reduce the risk of local recurrence²⁹. This effect was more pronounced in cases of large or recurrent tumors where wider excision with negative margins would lead to significant surgical morbidity. Radiotherapy is also recommended in cases of positive margins excision wherein further surgical resection may not be possible or will lead to significant morbidity (e.g. Amputation), to reduce the risk of local recurrence. This decision regarding the use of radiotherapy should be undertaken in a specialized tumour board setting to weight the benefits against risks.

Medical Treatment

As DFSP shows over expression of platelet derived growth factor receptors (PDGFR's) due to genetic translocation between chromosomes 17 & 22, targeting the PDGFR's may be an effective treatment option for DFSP. Imatinib, the tyrosine kinase inhibitor has been used in the medical management of DFSP and has shown some early fair response, particularly in recurrent, inoperable and/ or metastatic DFSP cases^{30,31}.

Conclusion

DFSP is a rare soft tissue sarcoma with a high rate of local recurrence and usually mismanaged. Treatment should be offered in specialized referral units in a multidisciplinary

setting with surgery being the mainstay of treatment. Radiotherapy may be of benefit in the adjuvant setting to reduce the risk of local recurrence in negative margins cases and should be offered in locally advanced cases where surgical morbidity may outweigh benefit, and in inoperable cases for local control. The role of Imatinib continues to evolve as medical treatment, with some early fair results. Long term follow up is advised according to locally agreed protocols to monitor for any delayed local recurrence.

Conflict of interest: None.

References

- Hoffmann E. I. Über das knollentreibende Fibrosarkom der Haut (Dermatofibrosarkoma protuberans). *Dermatology*. 1925;43(1-2):1-28. doi:10.1159/000250699
- McPeak CJ, Cruz T, Nicastrì AD. Dermatofibrosarcoma Protuberans: An Analysis of 86 Cases Five with Metastasis. *Annals of Surgery*. 1967 Nov;166(5):803-16. doi:10.1097/00000658-196711000-00011
- Pack GT. DERMATOFIBROSARCOMA PROTUBERANS: A Report of Thirty-Nine Cases. *AMA Arch Surg*. 1951 Mar 1;62(3):391. doi:10.1001/archsurg.1951.01250030397008
- Ibrahim M, Khan Z, Saeed M, Ahmad I, Kashif S, Khan A. Commonest modes of presentation of bone and soft tissue tumors at sarcoma services of A Tertiary Care Hospital of KPK. *The Professional Medical Journal*. 2020 Dec 10;27(12):2744-8. doi:10.29309/TPMJ/2020.27.12.4478
- Zou MH, Huang Q, Yang T, Jiang Y, Zhang L jing, Xie Y, et al. Role of ultrasound in the diagnosis of primary and recurrent dermatofibrosarcoma protuberans. *BMC Cancer*. 2021 Aug 10;21(1):909. doi:10.1186/s12885-021-08476-2
- Kashyap R, Muddu V, Anantamakula S, Sri S. Usefulness of¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography in dermatofibrosarcoma protuberans on treatment with imatinib. *Indian J Nucl Med*. 2016;31(3):191. doi:10.4103/0972-3919.181528
- Hao X, Billings SD, Wu F, Stultz TW, Procop GW, Mirkin G, et al. Dermatofibrosarcoma Protuberans: Update on the Diagnosis and Treatment. *JCM*. 2020 Jun 5;9(6):1752. doi:10.3390/jcm9061752
- Ibrahim M, Syed Asif Shah, Ahmed I, Khan MA, Khan Z. Is there an ideal method of reconstruction for proximal humerus osteosarcoma? A review of different reconstruction techniques. *J Pak Med Assoc*. 2023 Apr 15;73(05):1069-75. doi:10.47391/JPM.A.5452
- Hayakawa K, Matsumoto S, Ae K, Tanizawa T, Gokita T, Funauchi Y, et al. Risk factors for distant metastasis of dermatofibrosarcoma protuberans. *J Orthopaed Traumatol*. 2016 Sep 1;17(3):261-6. doi:10.1007/s10195-016-0415-x
- Martin L, Piette F, Blanc P, Mortier L, Avril MF, Delaunay MM, et al. Clinical variants of the preprotuberant stage of dermatofibrosarcoma protuberans. *Br J Dermatol*. 2005 Nov;153(5):932-6. doi:10.1111/j.1365-2133.2005.06823.x
- Dermatofibrosarcoma Protuberans: Update on the Diagnosis and Treatment [Internet]. [cited 2026 Jul 30]. Available from: <https://www.mdpi.com/2077-0383/9/6/1752>
- Suman S, Sharma P, Jain TK, Sahoo MK, Bal C, Kumar R. Recurrent Dermatofibrosarcoma Protuberans With Pulmonary Metastases Presenting Twelve Years After Initial Diagnosis: 18 F-FDG PET/CT Imaging Findings. *Clinical Nuclear Medicine*. 2014 Jan;39(1):77-8. doi:10.1097/RLU.0b013e318279f28e
- Hanabusa M, Kamo R, Harada T, Ishii M. Dermatofibrosarcoma protuberans with atrophic appearance at early stage of the tumor. *The*

- Journal of Dermatology. 2007;34(5):336–9. doi:10.1111/j.1346-8138.2007.00283.x
14. Bowne WB, Antonescu CR, Leung DHY, Katz SC, Hawkins WG, Woodruff JM, et al. Dermatofibrosarcoma protuberans. *Cancer*. 2000;88(12):2711–20. doi:10.1002/1097-0142(20000615)88:12<2711::AID-CNCR9>3.0.CO;2-M
 15. Barwani ASA, Taif S, Mazrouai RAA, Muzahmi KSA, Alrawi A. Dermatofibrosarcoma Protuberans: Insights into a Rare Soft Tissue Tumor. *J Clin Imaging Sci*. 2016 Apr 29;6. doi:10.4103/2156-7514.181492
 16. Mohamed M. Dermatofibrosarcoma protuberans with fibrosarcomatous transformation. In: Radiopaedia.org [Internet]. Radiopaedia.org; 2026 [cited 2026 Aug 3]. Available from: <https://radiopaedia.org/cases/228466> doi:10.53347/rID-228466
 17. Yong PFK, Grosse-Kreul D, Maher J, Salisbury JR, Ibrahim MAA. Dermatofibrosarcoma protuberans in a patient with X-linked agammaglobulinaemia. *J Clin Pathol*. 2007 Oct;60(10):1162–4. doi:10.1136/jcp.2006.044040
 18. Gloster HM. Dermatofibrosarcoma protuberans. *Journal of the American Academy of Dermatology*. 1996 Sep 1;35(3):355–74. doi:10.1016/S0190-9622(96)90597-6
 19. Torreggiani WC, Al-Ismail K, Munk PL, Nicolaou S, O'Connell JX, Knowling MA. Dermatofibrosarcoma Protuberans. *American Journal of Roentgenology*. 2002 Apr;178(4):989–93. doi:10.2214/ajr.178.4.1780989
 20. Usefulness of ¹⁸F-fluorodeoxyglucose positron emission tomography/computed tomography in dermatofibrosarcoma protuberans on treatment with imatinib - Indian Journal of Nuclear Medicine [Internet]. [cited 2026 Jul 30]. Available from: <https://ijnm.co.in/usefulness-of-18f-fluorodeoxyglucose-positron-emission-tomography-computed-tomography-in-dermatofibrosarcoma-protuberans-on-treatment-with-imatinib/>
 21. Ovid [Internet]. [cited 2026 Jul 30]. Fibrosarcomatous ('High-Grade')... : American Journal of Surgical Pathology. Available from: <https://www.ovid.com/jnls/ajsp/fulltext/00000478-199805000-00009~fibrosarcomatous-high-grade-dermatofibrosarcoma-protuberans>
 22. Llombart B, Monteagudo C, Sanmartín O, López-Guerrero JA, Serra-Guillén C, Poveda A, et al. Dermatofibrosarcoma protuberans: A clinicopathological, immunohistochemical, genetic (COL1A1-PDGFB), and therapeutic study of low-grade versus high-grade (fibrosarcomatous) tumors. *Journal of the American Academy of Dermatology*. 2011 Sep 1;65(3):564–75. doi:10.1016/j.jaad.2010.06.020 PubMed PMID: 21570152.
 23. Chappell AG, Doe SC, Worley B, Yoo SS, Gerami P, Alam M, et al. Multidisciplinary surgical treatment approach for dermatofibrosarcoma protuberans: an update. *Arch Dermatol Res*. 2021 Jul 1;313(5):367–72. doi:10.1007/s00403-020-02124-8
 24. Buck DW, Kim JYS, Alam M, Rawlani V, Johnson S, Connor CM, et al. Multidisciplinary approach to the management of dermatofibrosarcoma protuberans. *Journal of the American Academy of Dermatology*. 2012 Nov 1;67(5):861–6. doi:10.1016/j.jaad.2012.01.039
 25. Serra-Guillén C, Llombart B, Nagore E, Guillén C, Requena C, Traves V, et al. Mohs micrographic surgery in dermatofibrosarcoma protuberans allows tumour clearance with smaller margins and greater preservation of healthy tissue compared with conventional surgery: a study of 74 primary cases. *Br J Dermatol*. 2015 May 1;172(5):1303–7. doi:10.1111/bjd.13417
 26. Snow SN, Gordon EM, Larson PO, Bagheri MM, Bentz ML, Sable DB. Dermatofibrosarcoma protuberans: A report on 29 patients treated by Mohs micrographic surgery with long-term follow-up and review of the literature. *Cancer*. 2004;101(1):28–38. doi:10.1002/cncr.20316
 27. DuBay D, Cimmino V, Lowe L, Johnson TM, Sondak VK. Low recurrence rate after surgery for dermatofibrosarcoma protuberans. *Cancer*. 2004;100(5):1008–16. doi:10.1002/cncr.20051
 28. Meguerditchian AN, Wang J, Lema B, Kraybill WG, Zeitouni NC, Kane JM. Wide Excision or Mohs Micrographic Surgery for the Treatment of Primary Dermatofibrosarcoma Protuberans. *American Journal of Clinical Oncology*. 2010 Jun;33(3):300–3. doi:10.1097/COC.0b013e3181aaca87
 29. Chen YT, Tu WT, Lee WR, Huang YC. The efficacy of adjuvant radiotherapy in dermatofibrosarcoma protuberans: a systemic review and meta-analysis. *Journal of the European Academy of Dermatology and Venereology*. 2016;30(7):1107–14. doi:10.1111/jdv.13601
 30. Navarrete-Dechent C, Mori S, Barker CA, Dickson MA, Nehal KS. Imatinib Treatment for Locally Advanced or Metastatic Dermatofibrosarcoma Protuberans: A Systematic Review. *JAMA Dermatol*. 2019 Mar 1;155(3):361–9. doi:10.1001/jamadermatol.2018.4940
 31. Ugurel S, Mentzel T, Utikal J, Helmbold P, Mohr P, Pfoehler C, et al. Neoadjuvant Imatinib in Advanced Primary or Locally Recurrent Dermatofibrosarcoma Protuberans: A Multicenter Phase II DeCOG Trial with Long-term Follow-up. *Clinical Cancer Research*. 2014 Jan 15;20(2):499–510. doi:10.1158/1078-0432.CCR-13-1411

Figures

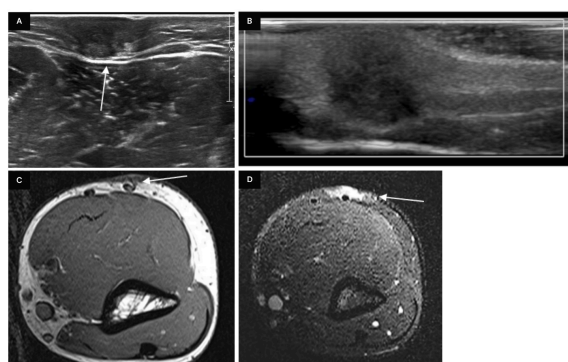


Figure 1A-1D: Ultrasound and MRI features of a subcutaneous DFSP on the volar aspect of antecubital fossa region.

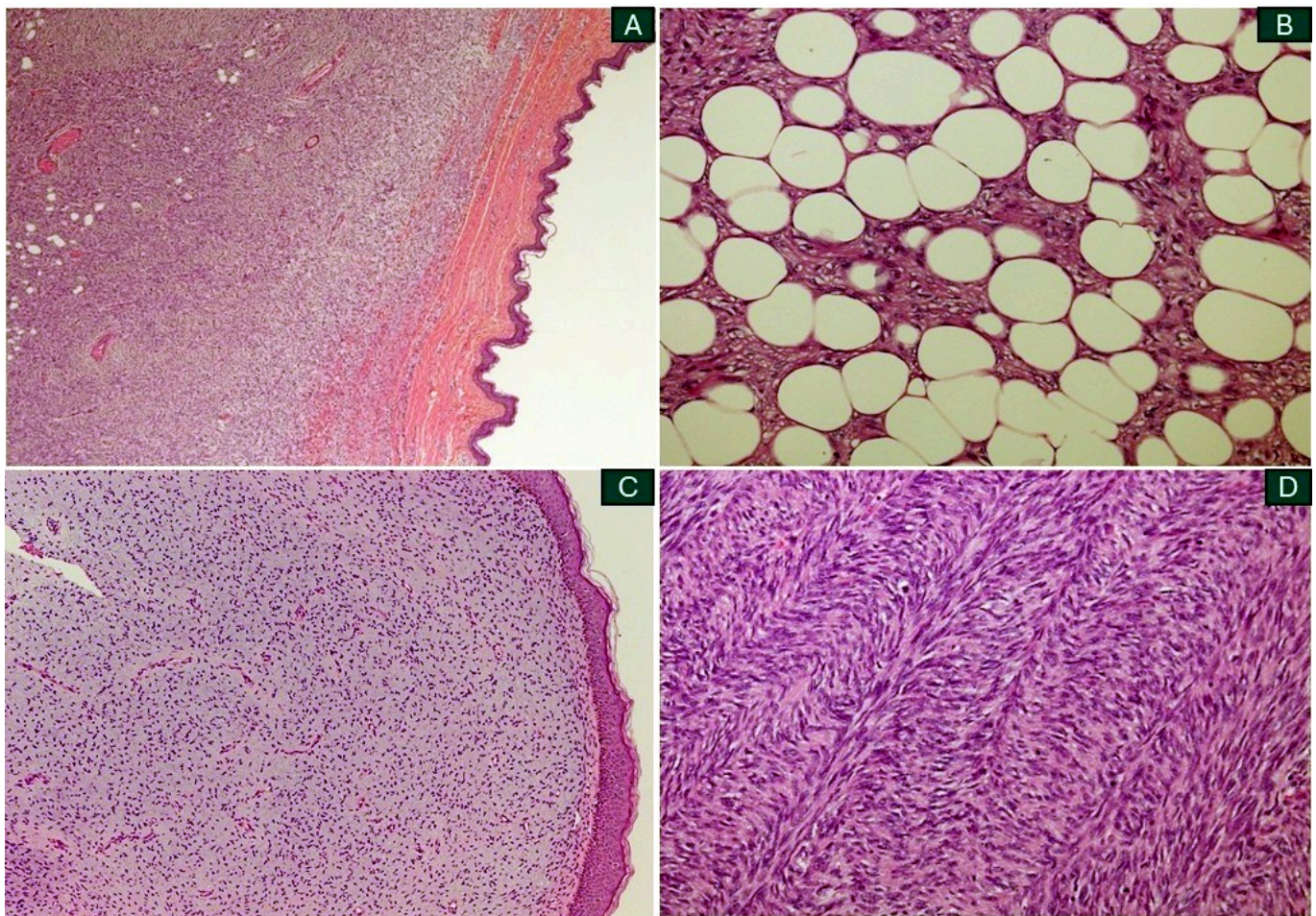


Figure 2:(A) Low-power view demonstrating a dermal-based spindle cell neoplasm with diffuse infiltration into the subcutaneous tissue and extension toward the overlying dermis. (B) Tumor cells infiltrating the subcutaneous adipose tissue in a characteristic honeycomb pattern. (C) Myxoid dermatofibrosarcoma protuberans (DFSP) showing hypocellular spindle cells embedded within abundant myxoid stroma. (D) Fibrosarcomatous transformation characterized by increased cellularity and intersecting fascicles arranged in a herringbone architecture.



Figure 3 (A-E): Third time recurrent DFSP on volar aspect of right forearm, with wide local excision followed by resection of defect with free Latissimus dorsi flap from contra lateral chest wall.