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A CROSS SECTIONAL RADIOGRAPHIC ASSESSMENT OF DEGENERATIVE CHANGES IN SHOULDER JOINT AMONG OLDER ADULTS WITH DIABETES MELLITUS AND HYPERTENSION

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Abstract

Diabetes mellitus and hypertension are two of the most common chronic conditions around the world. They are often associated with patients in their elder years. Diabetes mellitus and hypertension are known to damage the vascular and renal systems of the body, but what isn't commonly known is the damage they can inflict on the musculoskeletal system. Diabetic patients and hypertensive patients are known to suffer from joint deterioration, especially in the shoulder. Due to their intricate anatomy and extreme mobility the shoulder joint is prone to developing degenerative pathologies.Diabetes mellitus and hypertension can cause extra stress on the body's joints. Metabolic irregularities and lack of blood flow can cause early onset of degeneration of joint causing pain and stiffness.

The aim of this study is to evaluate radiographic degenerative early changes in the shoulder joint among older adults diagnosed with diabetes mellitus, and hypertension. The study also sought to

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assess the severity and pattern of these changes, and to determine their association with factors such as age and duration of disease.

A cross-sectional study design was employed, involving a sample of 80 patients recruited through non-probability convenience sampling from Mubarak Medical Complex and Accurate Diagnostic Centre. Participants included both males and females aged between 40 years and above age with confirmed diagnoses of diabetes mellitus and hypertension. Patients with a history of trauma, previous joint surgery, malignancy, or congenital abnormalities were excluded. Radiographic assessment of shoulder joint was done by routine X-ray imagining with Anteroposterior, lateral and oblique projections. Examination of collected data was done by using preformed proforma and analysis was done by using descriptive statistics.

The results showed that there was a significant number of cases with osteoarthritic changes in shoulder joint among diabetics and hypertensive patients. There was evidence of joint space narrowing, osteophyte formation, subchondral sclerosis and deformity which was graded as mild, moderate or severe. The changes were reported to be progressive with advancing age and duration of disease. These changes represent a strong correlation between metabolic vascular diseases and osteoarthritis.Patients with diabetes mellitus and hypertension are significantly involved in shoulder joint pathology. A plain radiograph gives an excellent and inexpensive opportunity for identifying shoulder osteoarthritis. An early diagnosis and management of shoulder joint arthritis can prevent disabilities.

Chapter 1
INTRODUCTION

Two of the most common chronic non-communicable diseases in the world and a significant burden on global health are diabetes mellitus (DM) and hypertension (HTN). Both disorders are closely linked to sedentary behavior, obesity, aging, and changes in lifestyle. They typically coexist in the same person and have similar pathophysiological causes, including oxidative stress, endothelial dysfunction, insulin resistance, and chronic inflammation. In addition to affecting critical organs including the heart, kidneys, and brain, this combination metabolic and vascular dysfunction has important ramifications for musculoskeletal health, especially the shoulder joint .

Diabetes mellitus (DM) and hypertension (HTN) are chronic metabolic and vascular disorders that are highly prevalent worldwide and often coexist in the same individual. Both conditions are associated with long-term microvascular and macrovascular changes that affect multiple organ systems, including the musculoskeletal system. In particular, the shoulder joint is frequently involved due to its dependence on adequate vascular supply and soft tissue integrity for normal function. Chronic hyperglycemia in diabetes leads to non-enzymatic glycation of collagen, resulting in stiffness of periarticular structures and increased risk of adhesive capsulitis and restricted shoulder movement. (1).

Persistent hyperglycemia brought on by deficiencies in insulin secretion, action, or both is an indicator of diabetes mellitus, a chronic metabolic disease. kind 2 diabetes is the most prevalent

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kind worldwide, and it can be broadly categorized as type 1, type 2, and gestational diabetes as well. Through processes like the production of advanced glycation end products, oxidative stress, and microvascular dysfunction, chronic hyperglycemia causes long-term harm to several organ systems. These pathological alterations have a substantial impact on tendons, joints, and connective tissues, resulting in discomfort, stiffness, and decreased mobility (2).

Persistently high arterial blood pressure is known as hypertension, and it is a significant risk factor for cardiovascular disease and death. Because it doesn't cause any symptoms until problems develop, it is sometimes referred to as a "silent killer." Reduced tissue perfusion, endothelial dysfunction, and vascular remodeling are all consequences of hypertension. These alterations contribute to degenerative changes in joints and soft tissues by impairing the microcirculation in musculoskeletal tissues and raising the risk of cardiovascular and renal illnesses (3).

It is quite frequent and clinically significant for high blood pressure and diabetes to coexist. Both disorders hinder normal tissue healing and hasten vascular damage. Tissue deterioration in diabetic hypertensive patients is caused by a combination of decreased blood flow, persistent inflammation, and metabolic dysfunction. In musculoskeletal systems like the shoulder joint, which rely on sufficient vascular supply and soft tissue integrity for optimal function, this combined effect is especially significant (4).

The shoulder joint is a complicated, highly mobile joint that is especially susceptible to metabolic and degenerative alterations. It is made up of surrounding soft tissues, ligaments, tendons, and bones that need the best possible circulatory and metabolic support. Tendons and joint capsules become stiff in diabetic patients due to non-enzymatic glycosylation of collagen. This procedure increases the risk of adhesive capsulitis, also referred to as frozen shoulder, and decreases flexibility. Furthermore, joint nourishment is compromised and synovial fluid quality is decreased by microvascular problems in diabetes (5).

By decreasing microvascular perfusion to periarticular tissues, hypertension exacerbates shoulder joint deterioration. Vascular stiffness and decreased oxygen delivery brought on by persistent high blood pressure hinder tissue regeneration and hasten degenerative processes. These vascular and metabolic abnormalities greatly raise the likelihood of shoulder discomfort, limited mobility, and functional impairment when paired with diabetes (6).

Diabetes mellitus has been strongly linked in clinical research to shoulder conditions, especially rotator cuff disease and adhesive capsulitis. Patients with diabetes have a markedly increased risk of developing shoulder stiffness as a result of joint capsule thickening and fibrosis. Similarly, degenerative alterations in musculoskeletal structures brought on by long-term vascular insufficiency have been connected to hypertension. Shoulder pathology is more severe and progresses more quickly when both diseases coexist (7).

Additionally, radiographic investigations have shown that early degenerative changes in the shoulder joint, such as joint space narrowing, osteophyte formation, and soft tissue calcification, are present in patients with diabetes and hypertension. Early imaging and diagnosis are crucial since these changes may manifest even before clinical symptoms worsen. In typical clinical

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practice, plain radiography is still a valuable and economical method for identifying such structural anomalies . According to epidemiological studies, shoulder issues are far more widespread in individuals with diabetes than in the overall population. According to certain studies, shoulder-associated conditions occur up to **25–30%,** of diabetes patients, highlighting the close connection between metabolic illnesses and musculoskeletal conditions. Furthermore, the length and severity of diabetes have been found to be significant risk factors for the emergence, of these problems (8).

Diabetes and hypertension have a particularly big effect on the shoulder joint in older people, who already have age-related deterioration. These people experience limited range of motion, stiffness, and persistent pain as a result of metabolic and circulatory diseases that hasten the development of joint degeneration. This leads to decreased quality of life and functional impairment, particularly in everyday activities requiring upper limb movement . When evaluating degenerative joint disorders, radiographic imaging is crucial. Due to its accessibility, affordability, and capacity to identify structural alterations in joint and bone structures**, traditional X-ray imaging** is often used. **Joint space narrowing, osteophyte formation, Subchondral sclerosis, cyst formation,** and **bone defects** are radiological, signs of progressive shoulder disease. These results offer important insights into the degree and course of joint deterioration. Furthermore, thorough a radiographic assessment is frequently dismissed in favor of clinical diagnosis and symptoms-based management throughout the literature currently in published form. Studies that systematically assess structural joint alterations using imaging methods are comparatively rare, especially in populations, with both diabetes and hypertension. (9).

From a therapeutic standpoint, it is critical to identify and treat musculoskeletal issues in patients with diabetes and hypertension as soon as possible. Strict glycemic control, blood pressure control, physical therapy, and lifestyle adjustment are examples of preventive techniques that can slow the progression of joint deterioration. For the best care of these individuals, multidisciplinary care combining doctors, radiologists, and physiotherapists is advised .In general, diabetes mellitus and hypertension have a substantial impact on musculoskeletal health, especially the shoulder joint, in addition to major organ systems. Together, they raise the chance of disability, decrease joint function, and hasten degenerative processes. Understanding this relationship is important for early diagnosis, prevention, and effective management of shoulder joint complications in affected patients (10).

In elderly patients, these degenerative changes often develop gradually and may remain asymptomatic in the early stages. As a result, many individuals do not seek medical attention until the condition progresses to a more advanced stage, presenting with pain, stiffness, and functional limitation. This delay in diagnosis can lead to significant disability and reduced quality of life. Early detection of joint changes is therefore essential for timely intervention and prevention of disease progression .Despite the clinical importance of this issue, most existing studies have examined the effects of diabetes or hypertension independently, rather than evaluating their combined impact on joint health. This represents a significant gap in the literature, as patients

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commonly present with both conditions simultaneously. Understanding the synergistic effect of DM and HTN on shoulder joint degeneration is crucial for developing more effective screening and management strategies (11, 12).

Due to their combined impact on several organ systems, diabetes mellitus, and hypertension commonly occur in elderly individuals and pose a serious therapeutic issue. Musculoskeletal degeneration is exacerbated by a combination of high blood sugar-induced tissue damage, and hypertension-associated vascular dysfunction. When relative to each issue alone, this combination disease can lead joint disorders to develop earlier, be more severe, and worsen more quickly. Despite being generally regarded as a cardiovascular condition, hypertension's impacts on cardiovascular condition have additionally been associated with musculoskeletal degeneration. Decreased capillary circulation, dysfunction of endothelial cells, and stiffness of the arterial system are all consequences of chronic high blood pressure. These vascular alterations hinder metabolic exchange and encourage degenerative changes by limiting the blood flow to bones and joint tissues. Subchondral bone ischemia, which is involved in the onset and advancement of osteoarthritis can also be a result of reduced perfusion. Conventional radiography is still the main diagnostic tool in many clinical settings, especially in settings with limited resources, even though highly advanced imaging modalities like MRI and ultrasound imaging provide complete visualization, of structures of soft tissue. It is a useful preliminary inquiry for detecting degenerative alterations and directing subsequent diagnostic and treatment choices. Numerous studies have examined the connection between musculoskeletal disorders, and diabetes mellitus, thus highlighting the part the inflammatory and metabolic functions play in joint deterioration. In a similar vein, studies on hypertensive condition, have shown how it promotes vascular damage and can play a part in the development of osteoarthritis. However, rather than analyzing the combined impact of these medical conditions on joint well-being, the vast majority, of research has focused on individual conditions (12).

This study is important because it focuses on the radiographic assessment of shoulder joint impairment in patients with high blood pressure, and diabetes mellitus. This study attempts to offer useful insights that can be readily applied in clinical practice, especially in settings with limited resources, by using simple and readily available imaging modality like X-ray imaging. As a result, many individuals do not seek medical attention until the condition progresses to a more advanced stage, presenting with pain, stiffness, and functional limitation. This delay in diagnosis can lead to significant disability and reduced quality of life. Early detection of joint changes is therefore essential for timely intervention and prevention of disease progression(13) .

The lack of region-specific data is yet another significant drawback, particularly in developing nations like Pakistan where the prevalence of diabetes, and hypertension is rising quickly. It is crucial to carry out local studies to produce pertinent, and useful data because variation in living standards. Availability of healthcare, and inherited traits may affect patterns of disease.Preventing the development of serious illness, requires early identification of degenerative joint alterations. However, elderly patients' symptoms related to muscles, and are frequently mistaken for signs of

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normal age, which causes a delay in diagnosis and therapy. This emphasizes the necessity of raising awareness about and regularly inspecting joint health in individuals with long-term systemic illnesses. The ultimate goal of this research is to enhance patient outcomes by encouraging early detection and treatment of musculoskeletal issues. Effective treatment of these disorders can greatly improve the quality of life for older people by lowering pain, increasing mobility, and reducing permanent disabilities (14) .

Progression of musculoskeletal involvement in patients with diabetes mellitus and hypertension is often gradual and clinically underestimated in early stages. Persistent metabolic imbalance in diabetes leads to accumulation of advanced glycation end products, which causes stiffness and reduced elasticity of periarticular structures. On the other hand, hypertension contributes to vascular narrowing and reduced oxygen delivery to musculoskeletal tissues, which delays healing and accelerates degenerative changes. When both conditions exist together, their effects are synergistic, leading to more severe structural and functional impairment of the shoulder joint. Patients may present with chronic pain, restricted movement, and difficulty in performing daily activities. Radiological findings often reveal early degenerative changes even before severe clinical symptoms appear. This highlights the silent but progressive nature of joint involvement in these patients. Therefore, early assessment and management are essential to prevent long-term disability(16).Early detection of radiographic changes in the shoulder joint is essential to **prevent progression toward severe disability**, especially in patients with chronic conditions like Diabetes Mellitus (DM) and Hypertension (HTN). **Plain X-ray** imaging can reveal early signs such as **joint space narrowing, osteophyte formation,** and **calcific deposits**, even before symptoms become prominent. Identifying these changes at an early stage allows timely intervention, including medical management and physiotherapy, which can slow disease progression and improve functional outcomes. Age is an important factor influencing shoulder joint degeneration, as structural wear and tear naturally increase over time. Radiographic findings tend to become more frequent and severe with advancing age due to reduced tissue repair capacity and cumulative mechanical stress. This relationship becomes more significant when metabolic disorders are present, as they accelerate degenerative processes. Additionally, the duration of **DM** and **HTN** plays a critical role in the extent of joint damage. Long-standing diabetes leads to collagen stiffness and capsular thickening, while prolonged hypertension impairs blood supply to joint tissues, contributing to degeneration. As the duration of these conditions increases, radiographic abnormalities become morepronounced, highlighting the importance of early diagnosis and regular monitoring to **prevent advanced joint pathology (15)**.

Aims and Objectives

- Early detection of radiographic findings to avoid severity.
- The correlation between age and radiographic shoulder joint changes.

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- The study examines the correlation between the duration of Diabetes Mellitus (DM) and Hypertension (HTN) and shoulder joint changes.

Chapter 2
LITERATURE REVIEW

Degenerative joint degeneration of the shoulder is an increasingly acknowledged aetiology of pain and functional impairment in the global ageing population. The glenohumeral joint, despite experiencing far lower axial loading compared to weight-bearing joints like the knee and hip, remains susceptible to progressive articular cartilage degradation, subchondral bone remodelling, osteophyte development, and periarticular soft-tissue pathology. These radiographic characteristics of osteoarthritis (OA) synergistically compromise the shoulder's distinctive blend of mobility and stability, leading to considerable morbidity in older persons(16).

Epidemiological data clearly indicate that the incidence of glenohumeral osteoarthritis significantly escalates with advancing age. Radiographic studies conducted on populations indicate that 16.1% to 20.1% of adults aged 65 and older display radiographic signs of glenohumeral osteoarthritis, with certain studies reporting figures as high as 85% to 94% in individuals over 80 years old (17).

In addition to age, an increasing body of evidence identifies chronic systemic comorbidities particularly diabetes mellitus (DM) and hypertension (HTN) as independent factors influencing both the initiation and severity of shoulder joint deterioration. Diabetes mellitus has extensive musculoskeletal effects via multiple interacting pathways, such as the buildup of advanced glycation end-products (AGEs), oxidative stress, microvascular impairment, and chronic low-grade inflammation(18) .

These processes together compromise collagen integrity, expedite tendon degeneration, and facilitate fibrotic capsular contracture conditions that manifest radiographically as calcific deposits, joint space constriction, osteophyte formation, and periarticular soft-tissue alterations. Hypertension, by affecting intraosseous perfusion and subchondral bone haemodynamics, introduces a new and unique vascular pathway that disrupts joint homeostasis(19).

Even though these comorbidities are clinically significant, there is a scarcity of targeted cross-sectional radiography evaluations that explicitly delineate degenerative shoulder alterations in older persons with concomitant diabetes mellitus and hypertension. Most current research has analysed the shoulder independently from systemic illness contexts or has concentrated on specific pathologies, such as adhesive capsulitis or rotator cuff tears, rather than the whole range of radiographic degenerative alterations. This literature analysis consolidates information from peer-reviewed research to establish the existing evidence base about the link between degenerative shoulder alterations and the dual comorbidity burden of diabetes mellitus and hypertension in older persons (20) .

There are many ways that the shoulder joint can wear down as we become older. Radiographically, Glenohumeral OA is characterised by non-uniform joint space narrowing, osteophyte formation at the inferior humeral head (the "goat's beard" sign), subchondral sclerosis, subchondral cyst

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formation, and, in advanced cases, posterior glenoid erosion with posterior subluxation of the humeral head. Altman et al. (2001) developed a foundational radiographic classification system for osteoarthritis, demonstrating that the principal radiographic indicators such as asymmetric joint space narrowing, subchondral sclerosis, osteophyte formation, cyst formation, and subluxation exhibit a systematic progression as articular cartilage degeneration occurs. The diagnosis of osteoarthritis mostly relies on clinical history and physical examination; nevertheless, radiographic findings are essential for establishing the diagnosis, evaluating severity, and ruling out alternative pathological disorders(21).

The grading system has been modified for the shoulder, enabling uniform measurement of osteophytes, joint space constriction, and subchondral sclerosis.It utilised this grading system in a study involving 44 patients with shoulder osteoarthritis undergoing total shoulder arthroplasty, employing standardised true anteroposterior, outlet, and axial radiography images. They showed a strong positive link between getting older and the severity of radiographic OA. They also noted that having diabetes mellitus was linked to these patients feeling more pain. It offered an extensive review of the aetiology and diagnostic criteria for glenohumeral osteoarthritis, affirming that standard anteroposterior and axillary views continue to be the primary imaging modalities for the assessment of glenohumeral osteoarthritis. A common observation in the initial phase of the disease is an inferomedial humeral osteophyte spur. Additional alterations encompass joint space narrowing, subchondral sclerosis and/or cyst formation, alongside osteophytes that are most effectively visualised in external rotation imaging(22).

The execution of a descriptive prospective cross-sectional investigation involving 73 individuals with shoulder pain. Radiographs identified abnormalities in 53% of instances, but ultrasonography identified diseases in 87% of cases. The most prevalent radiographic findings were osteoarthritis of the acromioclavicular joint, degenerative alterations in the greater tuberosity, and calcification of the rotator cuff. A notable correlation was identified between advanced age and the prevalence of larger tuberosity degenerative alterations and supraspinatus diseases(23).

He investigated 824 adult diabetics and 320 age- and sex-matched non-diabetics for calcifications on anteroposterior shoulder radiographs. Calcific deposits were found in 31.8% of diabetes patients, while only 10.3% of controls had them. This is a threefold difference that is very important for therapeutic practice. Long-term diabetes managed with prolonged insulin therapy was linked to an increased incidence of shoulder calcifications. This groundbreaking controlled study offered initial radiographic evidence of the expedited mineralisation processes happening in the shoulders of diabetes patients(24).

Utilising the National Health Insurance Research Database of Taiwan in a nationwide population-based matched cohort study of 42,915 patients newly diagnosed with diabetes mellitus (DM), established that

individuals with DM exhibited a 27% heightened risk of developing calcific tendinopathy of the shoulder within 8 years of DM diagnosis. In total, 122 patients from the DM group (0.284%) had calcific tendinopathy, while 340 individuals from the non-DM group (0.198%) did. The biological

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plausibility resides in the metabolic facilitation of ectopic calcium deposition via ischaemic and oxidative pathways linked to prolonged hyperglycaemia(25).

Histological and molecular investigations have significantly elucidated the mechanistic foundation by which DM facilitates shoulder joint degeneration. Mifune et al. (2022) examined the effects of diabetes- induced glycation and oxidative stress on human rotator cuff tissue. In the diabetic cohort, the mRNA expression levels of NADPH oxidase isoforms (NOX1, NOX4), interleukin-6 (IL-6), the receptor for advanced glycation end-products (RAGE), type III collagen, and matrix metalloproteinase-2 (MMP-2) were markedly raised, whereas the expression of type I collagen was dramatically diminished. The prevalence of reactive oxygen species (ROS)-positive cells and apoptotic cells was significantly elevated in diabetic rotator cuff tissue, corroborating that hyperglycemia-induced AGE and RAGE overexpression facilitates oxidative stress and apoptosis(26).

Expanded upon these findings by examining the correlation between AGE buildup in the shoulder capsule and range-of-motion restrictions in individuals with rotator cuff injuries linked to DM. Their research including sixteen patients having arthroscopic surgery revealed that the diabetic cohort exhibited markedly elevated levels of AGE and ROS, coupled with diminished cell viability. A notable positive association was identified among ROS expression, apoptotic rates, and pre-operative HbA1c levels, indicating that the extent of chronic glycaemic dysregulation directly influences the severity of capsular fibrosis and mobility limitation(27).

The amalgamated findings from many experimental and clinical research concerning the influence of diabetes mellitus on tendon disease. Their review emphasised that DM-induced pathogenic consequences on tendons encompass heightened free radical production, oxidative stress, inflammatory responses, accumulation of advanced glycation end-products (AGEs), and alterations in microvascular structures. All of these processes impair the structure, biomechanics, and ability to repair tendons. The proliferation of tendon stem cells diminishes, apoptosis escalates, and aberrant myofibroblast expression results in fibrosis and compromised remodeling an ensuing cascade that manifests as calcific tendinopathy, adhesive capsulitis, and degenerative rotator cuff tears in clinical and radiographic presentations(28).

A comprehensive review and meta-analysis concentrating on diabetes mellitus as a risk factor for the development of frozen shoulder. The analysis compiled information indicating that hyperglycemia enhances pro-inflammatory cytokine production in the synovium and joint capsule, and that inadequate long-term glycaemic control evidenced by raised HbA1c levels—is correlated with an increased prevalence of frozen shoulder. Microvascular dysfunction linked to diabetes mellitus was recognised as hindering capsular repair and increasing the risk of fibrotic contracture(29)

A cross-sectional study involving elderly diabetics with adhesive capsulitis, revealing that these patients endured significantly greater pain and functional impairment compared to non-diabetic individuals with similar levels of joint restriction. This finding supports the notion that diabetes mellitus alters the clinical manifestation of this condition beyond mere mechanical restriction.

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Their research included 233 individuals from hospitals in Udupi assessed diabetes and adhesive capsulitis used the Oxford Shoulder Score and the SF-36 quality of life instrument. The epidemiology and aetiology of AC among the United States Medicare population, utilising claims data from 2010 to 2012. A one-year prevalence rate of about 0.35% was found among persons aged 65 and older, which means that about 142,000 older adults live in the United States. Diabetes and Parkinson's disease were substantially correlated with the diagnosis of AC in the elderly. The scientists determined that initiatives aimed at mitigating chronic health issues, including diabetes, may also alleviate disorders that appear unrelated, such as AC(30).

A systematic evaluation of the prevalence of cardiovascular risk factors in osteoarthritis patients, utilising primary care electronic health information. They stated that OA patients exhibited a markedly elevated prevalence of hypertension (OR 1.25, 95% CI: 1.19–1.32), diabetes (OR 1.11, 95% CI: 1.02– 1.22), obesity, and dyslipidaemia in comparison to matched non-OA groups. This research identifies HTN as a crucial component of the metabolic-cardiovascular comorbidity profile that exacerbates OA severity at various joint locations. A detailed analysis published in Nature Reviews Rheumatology, delineated the several mechanisms by which increased blood pressure disturbs joint homeostasis. High blood pressure can raise the pressure inside bones and create hypoxia, which then leads to changes in the subchondral bone and the junction between the bone and cartilage. Moreover, systemic activation of the renin–angiotensin and endothelin systems can locally influence the Wnt–β-catenin signalling pathway to regulate the course of joint disease. A review that diminished arterial inflow and venous outflow blockage in the subchondral bone engender a hypoxic, acidic microenvironment. MRI and PET imaging have demonstrated that venous outflow blockage induces physicochemical alterations in subchondral bone, to which osteoblasts respond. These osteoblasts exhibit a modified cytokine profile, with numerous cytokines functioning as structural or signalling molecules that facilitate bone remodelling and cartilage degeneration results that directly correlate with the radiographic manifestations of subchondral sclerosis, cyst formation, and joint space narrowing(31).

He conducted experimental validation utilising spontaneously hypertensive rats in comparison to normotensive controls. After surgical induction of osteoarthritis (OA), hypertensive male rats exhibited a substantial increase in calcified subchondral bone compared to normotensive OA animals ($p = 0.043$).

In females, the coexistence of hypertension and osteoarthritis led to markedly reduced cartilage thickness and increased synovitis scores. These data collectively suggest that comorbid hypertension and osteoarthritis result in more pronounced subchondral bone disease, with vascular ischaemia identified as the principal underlying mechanism corresponding closely to radiographic observations of increased sclerosis and cyst formation in hypertensive individuals. The individual effects of DM and HTN on musculoskeletal health are well-documented; nevertheless, their synergistic influence on shoulder joint degeneration constitutes a significant clinical concern. Older persons often exhibit both illnesses concurrently, a situation attributable to their common metabolic foundation of insulin resistance, chronic inflammation, and endothelial dysfunction.

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The simultaneous presence of DM and HTN may result in a synergistic degradation of periarticular structures, rather than a merely additive effect.

The observance that in primary care patients with osteoarthritis (OA), the cardiometabolic cluster comprising hypertension, diabetes, obesity, and dyslipidaemia was significantly over-represented. This clustering indicates that the OA patient with concomitant DM and HTN constitutes a unique high-risk cohort necessitating focused radiographic monitoring. The shoulder, being a non-weight-bearing joint, may paradoxically face heightened risk from metabolic rather than mechanical factors, rendering the DM-HTN dyad particularly significant in the pathophysiology of glenohumeral degeneration. The evidence for microvascular mediation is further substantiated by the established association of retinopathy, nephropathy, and peripheral neuropathy in chronic diabetics with hypertension. Identified diabetic nephropathy as an independent predictor of osteoarthritis within their cross-sectional diabetes cohort, indicating that systemic vascular complications prevalent in both inadequately managed diabetes and hypertension serve as the ultimate common pathway through which articular cartilage and subchondral bone are adversely affected(32).

The methodological consistency of radiographic examination is a pivotal factor influencing the validity of findings in cross-sectional investigations of shoulder degeneration. Altman et al. (2001) stressed that radiographic findings, such as asymmetric joint space narrowing, subchondral sclerosis, osteophyte formation, subluxation, and distribution patterns, are essential for validating diagnosis, evaluating severity, and ruling out other pathological conditions. Roentgenograms of affected joints may assist in corroborating the diagnosis of osteoarthritis, evaluating the disease's severity, and providing reassurance to the patient. For glenohumeral OA, it is generally agreed that you should have at least two pictures: the true anteroposterior (Grashey) view and the axillary lateral image. The Grashey view is the best way to tell if the space between joints is getting smaller, while the axillary view is necessary to see how the glenoid wears down and to find out if the posterior humeral head is slipping out of place. More views, including the supraspinatus outlet view (Y view), make it easier to look at the shape of the acromion and the space between the acromion and the humerus that is important for rotator cuff impingement. Illustrated the synergistic function of radiography and ultrasonography in their prospective cross- sectional investigation. Radiographs revealed disease in 53% of instances, whereas ultrasonography discovered abnormalities in 87%, indicating that conventional radiographs despite being crucial and accessible tend to underestimate soft-tissue pathology. For older persons with diabetes mellitus and hypertension, where subclinical tendon deterioration may be pronounced before osseous alterations, a dual-modality approach integrating plain radiography and ultrasound would yield the most comprehensive evaluation. Two independent, experienced shoulder surgeons analysed all of the radiographs and came to a consensus. This standardised methodology enables dependable epidemiological comparisons among varied study groups and is advised for cross-sectional radiography investigations examining comorbidity-associated shoulder deterioration. The studied literature collectively substantiates numerous principal results. First, becoming older is still the

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main cause of radiographic glenohumeral OA, with estimates of 16–20% of persons over 65 years old having it. Second, DM considerably hastens shoulder degeneration via AGE accumulation, oxidative stress, collagen dysregulation, and microvascular impairment, which are evident radiographically as calcific deposits, accelerated joint space constriction, and periarticular soft-tissue pathology. Third, HTN creates its own vascular channel through intraosseous ischaemia and subchondral bone remodelling. Fourth, the co-occurrence of diabetes mellitus (DM) and hypertension (HTN) in older persons results in a high-risk metabolic phenotype necessitating clinical radiography surveillance of the shoulder.There are still some holes in the current evidence foundation. There are not many studies that have directly compared radiographic shoulder results in older persons with DM alone, HTN alone, both DM and HTN, or neither disease. Most current studies have focused on weight-bearing joints, especially the knee, while shoulder-specific radiography data remains relatively scarce. The geographic diversity of study populations is a restriction, as several extensive epidemiological studies are derived from high-income contexts, although the greatest prevalence of inadequately managed diabetes mellitus and hypertension may be found in low- and middle-income nations(33).

Longitudinal radiography follow-up investigations are necessary to ascertain if diabetes mellitus and hypertension independently forecast the advancement of degenerative shoulder alterations over time. Cross-sectional designs are suitable for estimating prevalence but are incapable of determining causal directionality. Subsequent research must implement standardised radiography techniques that encompass several views, established grading systems, and well specified diagnostic criteria for both diabetes mellitus (DM) and hypertension (HTN) to guarantee the comparability of findings across diverse populations(34).

The existing literature presents robust evidence that degenerative alterations in the shoulder joint are markedly affected by the systemic comorbidities of diabetes mellitus and hypertension, especially in the elderly population. Radiographic characteristics of glenohumeral osteoarthritis—joint space narrowing, osteophyte formation, subchondral sclerosis, cyst formation, and calcific deposits—are more common and severe in patients with diabetes mellitus and hypertension than in normoglycemic, normotensive counterparts of same age. The pathophysiological basis of this association encompasses interacting metabolic (AGE accumulation, oxidative stress, collagen dysregulation) and vascular (intraosseous ischaemia, subchondral bone hypoxia, angiogenic dysregulation) mechanisms that converge on the glenohumeral and periarticular structures(35).

A cross-sectional radiographic evaluation employing standardised anteroposterior and axillary projections, alongside validated grading systems, provides a pragmatic and evidence-based methodology for delineating this load within the at-risk population. The results of these studies are anticipated to exert direct influence on the clinical management of shoulder pain in older adults with diabetes mellitus (DM) and hypertension (HTN), guiding both radiographic monitoring protocols and multidisciplinary management approaches that tackle articular degeneration alongside the associated cardiometabolic comorbidities. Subsequent investigations utilising specialised cross-sectional radiography methodologies with distinctly defined DM and HTN

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subgroups will significantly enhance the comprehension of this clinically pertinent correlation (36).

Older people, especially those with chronic conditions like diabetes and high blood pressure, are quite concerned about abnormalities in the shoulder joint that get worse over time. These systemic illnesses

are known to speed up the breakdown of the musculoskeletal system by harming the small blood vessels, producing long-term inflammation, and messing with the body's metabolism. These diseases are getting more common as people become older, so it's very important to evaluate the condition of these patients' joints. Radiographic examination is a useful technique to discover and keep an eye on these kinds of degenerative changes without having to do surgery. It tells you how bad the joint problem is and how it is becoming worse(37).

Chapter 3
METHODOLOGY

3.1. RESEARCH DESIGN

A cross-sectional study approach was adopted in this investigation.

3.2. CLINICAL SETTING

The Mubarak Medical Complex and Accurate Diagnostic Center served as the study's locations.

3.3. SAMPLE SIZE

There were fifty patients in all. In order to give enough information for precise radiographic examination and comparison, the sample size was established.

3.4. SAMPLING TECHNIQUE

Convenience sampling, which is non-probability, was employed. Patients who met the inclusion criteria and were between the ages of **30** and **50** and who consulted the hospital and diagnostic facility during the study period were enrolled.

3.5. DURATION OF STUDY

The study was conducted over a four-month period.

3.6. SELECTION CRITERIA

3.6.1. Inclusion Criteria:

- 30 to 50 years of age.
- Both sexes.
- Clinical history reported.
- Verified diagnosis of high blood pressure and type two diabetes.
- Accessibility of radiographic assessment, particularly for the shoulder joint.

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3.6.2. Exclusion Criteria:

- Past injuries to the shoulder joint.
- Previous joint or bone surgery, such as orthoplasty,Chronic corticosteroid treatment.
- Cancer.
- Congenital shoulder joint anomalies.
- Imaging Protocol and Equipment
- Using traditional X-ray technology, radiographic assessments of the shoulder joint were carried out in accordance with radiation precautions and routine procedures for imaging.

Method of Radiography:

The following typical projections were part of the examination of the shoulder joint:

- Anteroposterior (AP) view: A view of the shoulder joint from front to rear.
- **Lateral view**: The joint of the shoulder seen from the side.
- **Oblique view**: An angled projection used to assess the bone anatomy and shoulder joint area.

3.7. ETHICAL CONSIDERATIONS

- Written informed consent was obtained from every participant after the aims of the study, the imaging procedure, and any potential radiation exposure had been explained in language the patient understood.
- All radiography records and all associated records were de-identified before analysis to safeguard patient privacy.
- Imaging was only performed where the clinical benefit clearly outweighed the risk, ensuring that no patient was exposed to unnecessary radiation.
- Radiographic data and patient information were used exclusively for research purposes and for no other application.T
- To keep patient welfare central, X-rays were taken only when a clinical indication was already present.
- Every piece of information and clinical information obtained during the study was stored confidentially throughout.
- Participants were informed that the non-invasive nature of the radiographic examination itself carries no direct procedural risk or negative aspects.
- Only approved clinical workers have limited access.
- We will safeguard the confidentiality of each patient without exception.
- Ensuring that results and imaging records were shared only with the patient, the attending clinicians, and the research team.
- Participants were also clearly told that they could withdraw from the study, at any stage, without any effect on their ongoing clinical care.Enrollment was entirely voluntary, and no direct, personal benefit was promised to participants. though the findings generated were expected to add

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useful evidence to the wider clinical literature.

- Informed consent was obtained from every participant after the aims of the study, the imaging procedure and any potential radiation exposure had been explained in language the patient understood.

3.8. DATA COLLECTION PROCEDURE

Data collection followed a structured protocol that paired clinical assessment with a standardized recording format so that shoulder-joint findings could be consistently evaluated and compared between patients with and without the dual diagnosis. The primary outcomes of interest were the severity of shoulder-joint changes and their simple presence or absence coded as a binary variable. Severity grading drew on several domains mobility, joint morphology, joint space, cortical margin definition, and bony deformity when determining severity. A calibrated X-ray unit, operated by a qualified radiographer under the supervision of a certified radiologist, was used for data acquisition and for carrying out the full bilateral shoulder radiographic examination.Important clinical and demographic information including age, sex, duration of diabetic and hypertensive disease, and the affected shoulder was entered onto a pre- designed data-collection form. Complete radiographic images, a structured patient questionnaire, past medical history, and supporting investigations such as random blood sugar (BSR), body mass index (BMI), and blood pressure status were used together as the data capture tools for the present study. A non-probability, convenience sampling strategy was applied within a descriptive, cross-sectional research framework. Any eligible patient between 30 and 50 years of age who presented to the participating hospital or diagnostic center during the four-month recruitment window will be included in the study.Key demographic and clinical variables age, sex, duration of diabetes or hypertension, and the affected shoulder were entered on a uniform data-collection sheet used across both sites.Data-collection instruments comprised a structured questionnaire, the patient's clinical history, the shoulder radiographs themselves, and supporting measurements such as BMI, hypertensive status, and BSR.

3.9. DATA ANALYSIS

In this study, 50 patients' radiography results and the age distribution of shoulder joint illnesses were assessed. The results of the descriptive statistical analysis are displayed as frequencies, percentages, and graphical representations (bar and pie charts).Thirteen out of fifty patients (26%) had reduced shoulder movement, according to the analysis. Eight of these scenarios fell into the moderate category, three into the mild category, and one into each of the severe and questionable categories. Functional limitation is typically shown at an intermediate severity level rather than significant impairment, as the bar chart shows that moderate restriction is the most common pattern.Twelve patients (24%) had joint space constriction, of which ten had mild narrowing and two had substantial narrowing. The graphical representation clearly demonstrates a majority of moderate modifications, indicating that in the population under study, early degenerative alterations are more common than advanced joint space decrease. Six individuals (12%) had

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osteophyte formation, with moderate instances (4) outnumbering mild cases (2). In comparison to other studies, the bar chart shows a comparatively lower frequency, suggesting that osteophyte growth is less common yet typically manifests, with moderate severity when it does occur.The least frequent finding was subchondral modifications, which were seen in three individuals (6%), two of which were moderate and one of which was mild. The modest dispersion in the accompanying graphic indicates that subchondral involvement is not very common in this cohort.Six patients (12%) had bone deformities, which were classified as mild (1 case), severe (2 cases), and moderate (3 cases). The dispersion across severity levels shown in the bar chart reflects the variation in the course of the disease among those who are afflicted.Furthermore, 10 individuals (20%) were categorized as normal, meaning that there were no radiographic anomalies. The overall burden of shoulder joint disease in the sample is highlighted by the fact that abnormal cases together account for the bulk of pathological findings.According to the combined graphical and tabular analysis, the majority of radiographic findings show as moderately severe. Early degenerative alterations, such as moderate constriction, constriction of the joint space, are more common than severe stages. Mobility restriction and constriction of joint space are more common than subchondral alterations. The prevalence of the condition increases with age, with people between the ages of 46 and 50 having the highest burden. Additionally, women are more likely than males to have DM and HTN, which increases their risk of developing shoulder joint illness. According to the statistics, age has a major role in the onset and progression of shoulder joint disease with diabetes and hypertension.

Table:1 "Radiographic Distribution of Degenerative Shoulder Joint Changes among Older Adults with Diabetes Mellitus and Hypertension (n=50)"

Shoulder mobility	13/50 patients	(**26**% cases)	Mild 3 Moderate 8 Severe 1 Doubtful 1
Space Narrowing	12/50 patients	(**24**% cases)	Mild 10 Moderate 2
Osteophyte formation	6/50 patients	(**12**% cases)	Moderate 4 Mild 2
Subchondral sclerosis	3/50 patients	(**6**% cases)	Moderate 2 Mild 1

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Bone deformity	6/50 patients	(12%)	Severe 2 Moderate 3 Mild 1
Normal	10/50 patients	(20%)	Normal

The study group (n=50) of older people with diabetes and high blood pressure showed different levels of degenerative changes in their shoulder joints when they were X-rayed. Limited shoulder movement was the most prevalent thing to witness, happening in 13 people (26%) of the time. Most of these cases were thought to be of medium severity. Twelve patients (24%) showed joint space constriction, but most of it was rather mild.

Osteophyte development and bone deformation were detected in 6 people (12%). The creation of osteophyte was usually moderate, although bone deformation happened more equally, with mild, moderate, and severe cases. Subchondral sclerosis was the least common outcome, seen in only 3 individuals (6%), and it mostly showed up as mild to severe changes.

Furthermore, 10 individuals (20%) had no radiographic abnormalities and were classified as normal. The results demonstrate that degenerative changes in the shoulder joint are highly common in elderly people with diabetes and high blood pressure. Most of the time, these alterations are mild to moderate in severity.

3.9.1 Age-wise Analysis

The prevalence of shoulder joint anomalies is strongly correlated with advancing age, according to age distribution research. Abnormal instances (8) were marginally fewer than normal cases (9) in the 35–40 age range, indicating that younger people's joint health was comparatively intact.On the other hand, there were significantly more aberrant findings in the 41–45 age range, with 20 cases as opposed to just one normal case. This suggests a crucial stage of transition where degenerative alterations become noticeably more noticeable.With all 12 cases categorized as abnormal and no normal findings recorded, the age range of 46–50 years showed the highest illness burden. This indicates a total transition in older people toward pathological problems..

Chapter 4

RESULTS

4.1 OvervieoStatisticaAnalysis

This chapter reports the outcomes of the cross-sectional radiographic study performed on fifty older patients living with a dual diagnosis of diabetes mellitus (DM) and hypertension (HTN). Participants were aged 35 to 50 years and were recruited through non-probability convenience sampling at Mubarak Medical Complex and Accurate Diagnostic Centre. Conventional shoulder radiography was carried out for every patient using the three standard projections: anteroposterior

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(AP), lateral, and oblique.Six radiographic parameters were reviewed on every film: restriction of shoulder mobility, joint space narrowing, formation of osteophytes, subchondral sclerosis, subchondral cyst development, and bony deformity. Each of these was graded using a five-point scale adapted from the Kellgren–Lawrence and Samilson–Prieto classifications, running from Grade 0 (Normal) through to Grade 4 (Severe).Descriptive statistics and graphical summaries were used to organize the data. Differences between age groups in the pattern of normal and abnormal findings were examined with the Pearson chi- square (χ^2) test. A one-way ANOVA was applied to compare mean composite severity scores across the three age bands, and Pearson and Spearman correlation coefficients were calculated to assess the strength of the age–severity relationship. A p-value below 0.05 was taken as the threshold for statistical significance. All analyses were performed and cross-checked in Microsoft Excel.

4.2 Demographic Distribution of Participants

All fifty patients had confirmed clinical diagnoses of both type 2 diabetes and hypertension, consistent with the inclusion criteria. For the age-based analysis, the cohort was divided into three five-year age groups: 35–40, 41–45, and 46–50 years. The middle bracket (41–45 years) accounted for the largest share at 21 patients (42.0%), followed by the 35–40-year group at 17 patients (34.0%) and the 46–50-year group at 12 patients (24.0%). The distribution covered the full 35–50-year span reasonably evenly and allowed sensible comparisons between younger and older participants.

CONTINGENCY DISTRIBUTION OF PATIENTS

Age Group (years)	Abnormal n (%)	Normal n (%)	Frequency (n)	Overall Percentage
35 – 40	8 (47.1%)	9 (52.9%)	17	34%
41 – 45	20 (95.2%)	1 (4.8%)	21	42%
46 – 50	12 (100.0%)	0 (0.0%)	12	24%
Total	40 (80.0)	10 (20.0)	50	100%

4.3 Overall Prevalence of Radiographic Findings

Every patient was categorized according to the dominant radiographic abnormality detected on plain film. The frequencies and percentages for each finding are shown in Figure 4.1.

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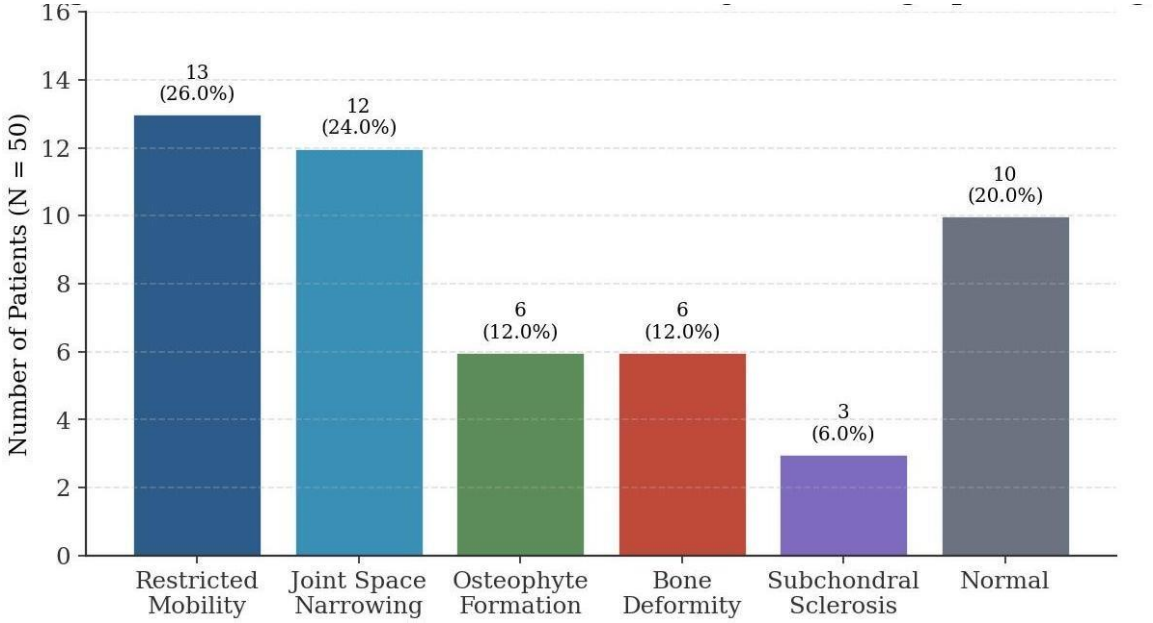

Figure 4.1: Overall prevalence of shoulder joint radiographic findings (N = 50)

Figure 4.1 shows that 40 of the 50 patients (80.0%) had at least one shoulder abnormality on radiography, leaving only 10 patients (20.0%) with a radiographically normal study. Restricted shoulder mobility topped the list at 13 patients (26.0%), with joint space narrowing close behind at 12 patients (24.0%). Osteophyte formation and bone deformity were each observed in 6 patients (12.0%), and subchondral sclerosis was the least frequent at 3 patients (6.0%). No patient had subchondral cyst formation as the predominant finding. Overall, the pattern points to a considerable burden of shoulder joint degeneration in older adults who live with the combination of diabetes and hypertension.

4.4 Severity Distribution of Individual Parameters

To appreciate the clinical severity more precisely, each radiographic parameter was examined separately. The resulting severity profile across all five observed parameters is summarized Figure 4.2.

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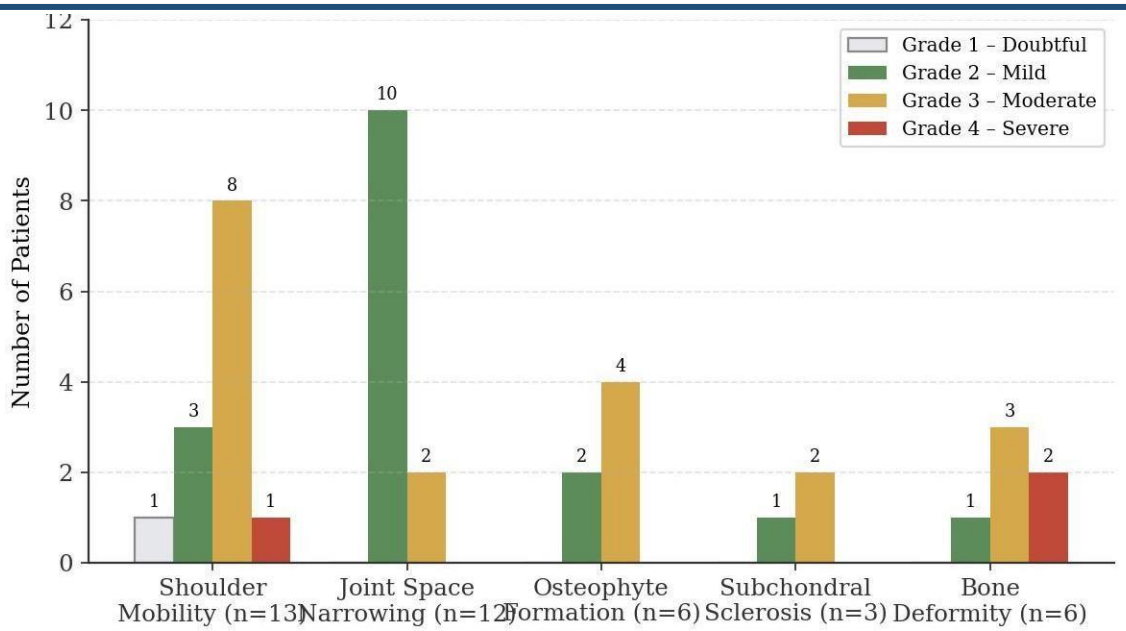

Figure 4.2: Severity grade distribution across radiographic parameters

4.5 Within the 13 patients who had reduced shoulder mobility, the majority (61.5%) sat at Grade 3 moderate restriction, while 23.1% fell at Grade 2 mild restriction. Grade 1 doubtful and Grade 4 severe findings were each seen in one patient (7.7% each). Mobility restrictions, therefore, tended to cluster around the moderate level, with truly severe limitations being rare in this cohort.Joint space narrowing was predominantly a mild finding. Ten of the 12 affected patients (83.3%) had Grade 2 mild narrowing, and only 2 patients (16.7%) progressed to Grade 3 moderate narrowing. No case of severe narrowing was recorded. In other words, while this abnormality was common overall, it was usually caught at an earlier stage within this population.Among the 6 patients with osteophyte formation, 4 (66.7%) were graded as Grade 3 moderate and 2 (33.3%) as Grade 2 mild. No severe osteophytosis was documented in the cohort. This suggests that once osteophytes have formed, they commonly declare themselves at an intermediate stage, rather than sitting at either extreme of the grading scale.Subchondral sclerosis came out as the least common finding across the whole cohort. Of the 3 affected patients, 2 (66.7%) were at Grade 3 moderate sclerosis, and 1 (33.3%) was at Grade 2 mild. Its low frequency lends weight to the view that subchondral bony reaction is a later, less commonly encountered feature in middle-aged patients with combined diabetes and hypertension.Bony deformity displayed the broadest spread across severity grades. Among the 6 affected patients, 3 (50.0%) had Grade 3 moderate deformity, 2 (33.3%) had progressed to Grade 4 severe, and 1 (16.7%) remained at Grade 2 mild. The fact that a third of those affected had reached severe deformity points to more advanced joint degeneration within this subgroup.

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4.6. Age-wise Distribution of Normal and Abnormal Findings

To examine how age influenced shoulder degeneration, normal and abnormal findings were cross-tabulated against the three age brackets. The resulting distribution is displayed in Figure 4.3.

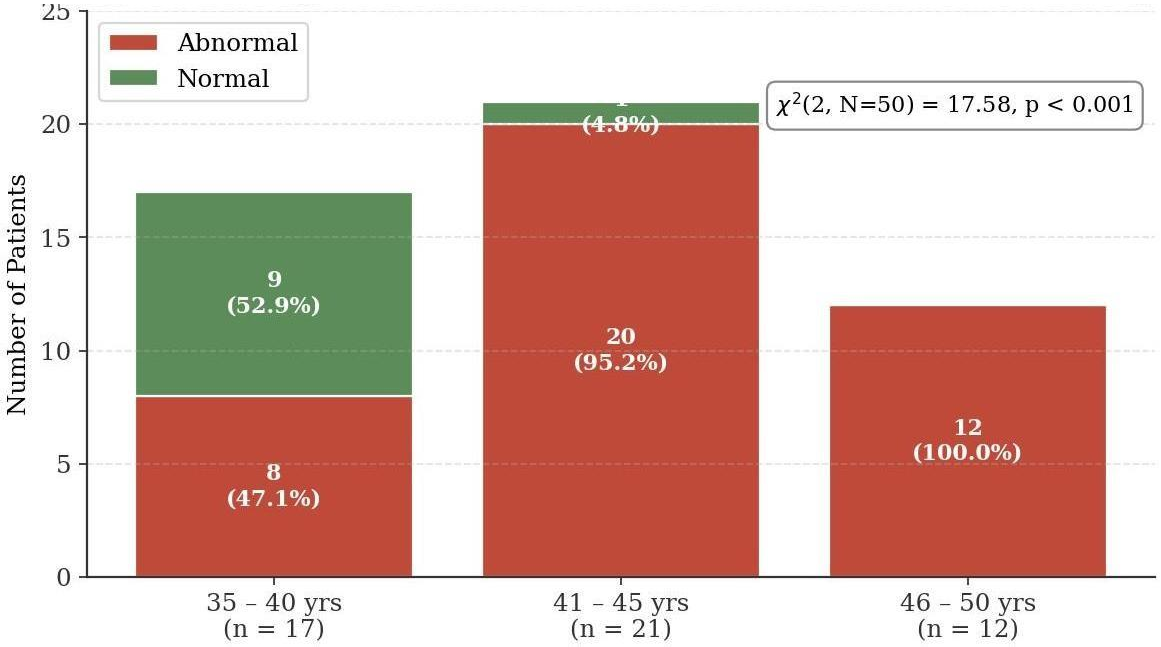

Figure 4.3: Age-wise distribution of normal versus abnormal radiographic findings

The rise in shoulder abnormalities with advancing age is striking. In the 35–40 years bracket, 8 of 17 patients (47.1%) had abnormal findings while 9 (52.9%) remained normal — a roughly even split. In the 41–45 years group, abnormal findings jumped sharply to 95.2% (20 of 21 patients), with only a single normal case remaining. By the 46–50 years group every participant (100.0%, 12/12) showed at least one abnormal finding; no normal cases were recorded in this age group.

Variable	χ^2 value	df	p-value	Interpretation
Age group vs Radiographic findin gs	17.58	2	<0.001	Statistically significant

A Pearson chi-square test of independence was carried out to test the association between age group and the presence of radiographic abnormalities. The result was statistically significant:

χ^2 (df = 2, N = 50) = 17.58, $p < 0.001$

A strong and statistically significant link therefore exists between age group and radiographic

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shoulder degeneration. Because some expected cell counts fell below 5, Fisher's exact test (Freeman–Halton extension) was also applied as a safeguard, and it likewise confirmed a highly significant association ($p < 0.001$). Advancing age therefore stands out as a major contributor to shoulder joint degeneration in patients with coexisting diabetes mellitus and hypertension.

Test	P-value	Interpretation
Fisher's Exact Test (Freeman–Halton)	<0.001	Statistically significant

Age-wise Distribution by Specific Radiographic Finding

To look more closely at how degenerative changes distribute across age groups, each specific radiographic abnormality was broken down by age bracket. The resulting patterns are presented in Figure 4.4.

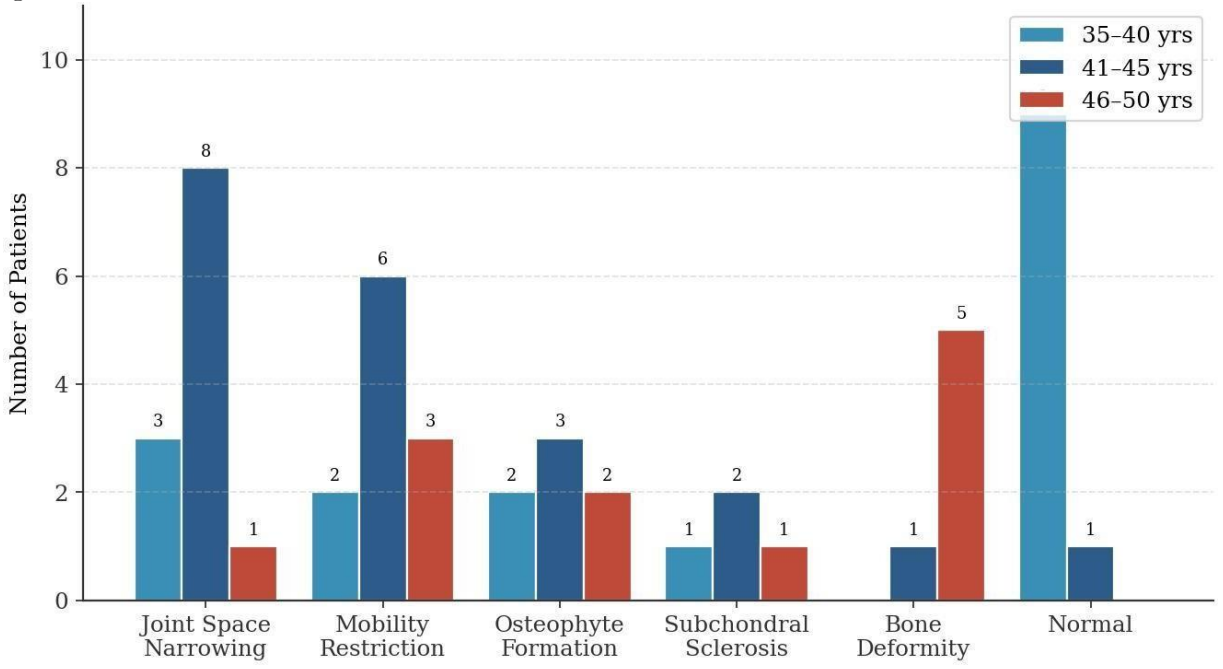

Figure 4.4: Age-wise distribution of specific radiographic findings

Clear age-linked patterns emerged. In the youngest group (35–40 years), joint space narrowing (n = 3) led as the single most common finding, with osteophyte formation (n = 2) and restricted shoulder mobility (n = 2) following closely behind. Notably, bone deformity was not encountered at all in this youngest bracket evidence that early-stage changes dominate over advanced structural

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damage in younger patients. In the 41–45 year group, joint space narrowing again took the lead (n = 8), followed by restricted shoulder mobility (n = 6) and osteophyte formation (n = 3). The first appearance of bone deformity in this bracket (n = 1) signals the start of more advanced degenerative findings.

The picture shifted sharply in the oldest group (46–50 years). Here, bone deformity emerged as the dominant finding (n = 5), accounting for nearly half of all abnormalities in this bracket. Restricted shoulder mobility (n = 3) and osteophyte formation (n = 2) followed. This shift towards more severe structural abnormalities in the oldest patients underscores the progressive nature of shoulder degeneration with advancing age.

4.5 Overall Radiographic Impression

By combining the severity grades of all radiographic findings for each patient, an overall radiographic impression was assigned in one of four categories: Normal, Mild, Moderate or Severe Degenerative Changes, in line with the impression section of the study proforma (Appendix C). The distribution across these categories is shown in Figure 4.5.

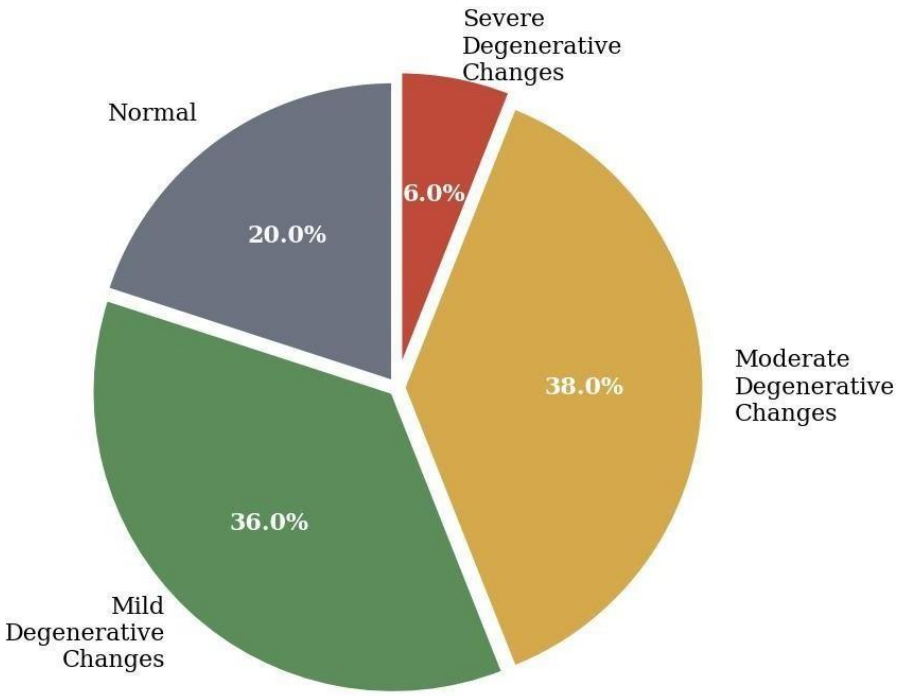

Figure 4.5: Overall radiographic impression distribution (N = 50)

As shown in Figure 4.5, 20.0% of patients (n = 10) were radiographically normal. Mild degenerative changes were identified in 36.0% (n = 18), moderate in 38.0% (n = 19), and severe in only 6.0% (n = 3). The majority of affected patients — 74.0% of the whole cohort — fell within the

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mild-to-moderate spectrum. Severe degeneration, by contrast, was the exception rather than the rule. Clinically, this pattern matters: shoulder joint degeneration in this population most commonly presents at an early-to-intermediate stage, and catching it at this point offers the best chance of effective management and slowing further progression.

4.6 One-way ANOVA across Age Groups

In addition to the categorical chi-square analysis, a one-way analysis of variance (ANOVA) was run to determine whether the mean composite severity score differed meaningfully across the three age brackets. Each patient was assigned a composite score from 0 to 3 based on their overall radiographic impression (Normal = 0, Mild = 1, Moderate = 2, Severe = 3). Group means together with their dispersion are plotted in Figure 4.6.

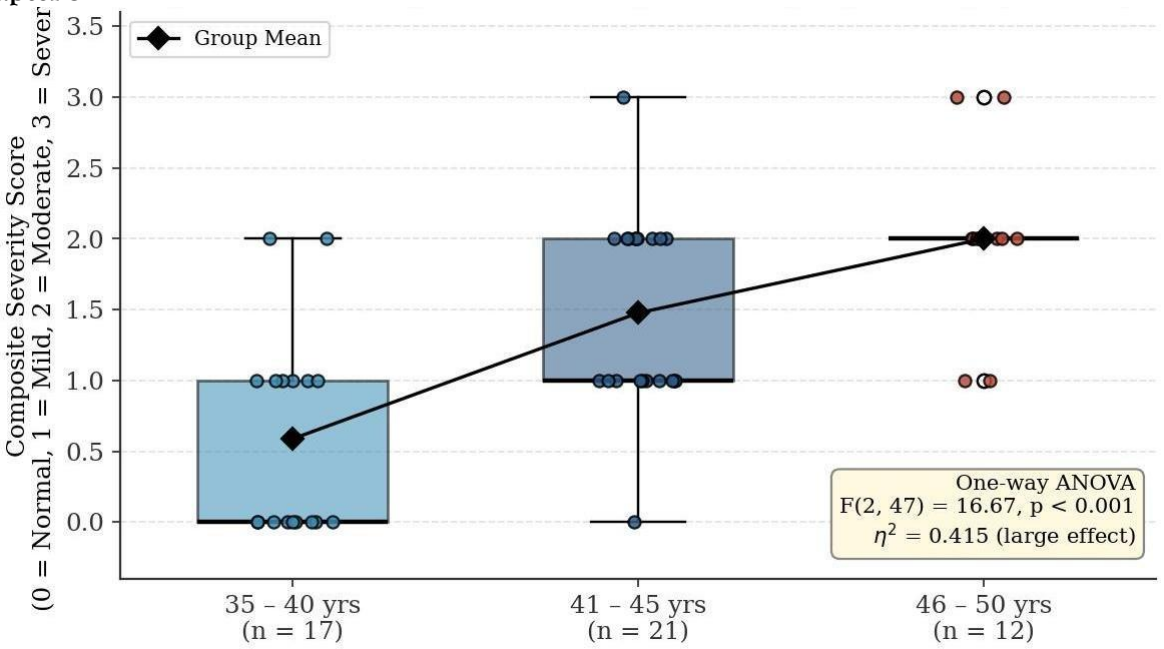

Figure 4.6: Composite severity score distribution across age groups with ANOVA results

The mean composite severity score rose in a step-wise fashion with advancing age: 0.59 (SD = 0.71) in the 35–40 year group, 1.48 (SD = 0.68) in the 41–45 year group and 2.00 (SD = 0.60) in the 46–50 year group. The one-way ANOVA showed a highly significant difference between the groups: $F(2, 47) = 16.67$, $p < 0.001$, $\eta^2 = 0.415$

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Source of Variation	df	F-value	p-value	Effect Size (η^2)
Between Groups	2	16.67	<0.001	0.415

An eta-squared value of 0.415 represents a large effect size, meaning that around 41.5% of the variability in shoulder degeneration severity can be accounted for by age group alone. Because the composite score is ordinal, a non-parametric Kruskal–Wallis test was run as a sensitivity check, and it returned the same conclusion ($H = 20.15$, $p < 0.001$). These results strengthen the argument that age is not merely linked to the presence of abnormality, as shown earlier in Section 4.5, but is also a driver of how severe that shoulder degeneration becomes within this patient group.

4.7 Correlation between Age and Severity of Degeneration

To measure the strength and direction of the age–severity relationship more precisely, a correlation analysis was performed. Patient age (taken as the midpoint of each bracket) was correlated with the composite severity score, and the resulting relationship is plotted in Figure 4.7.

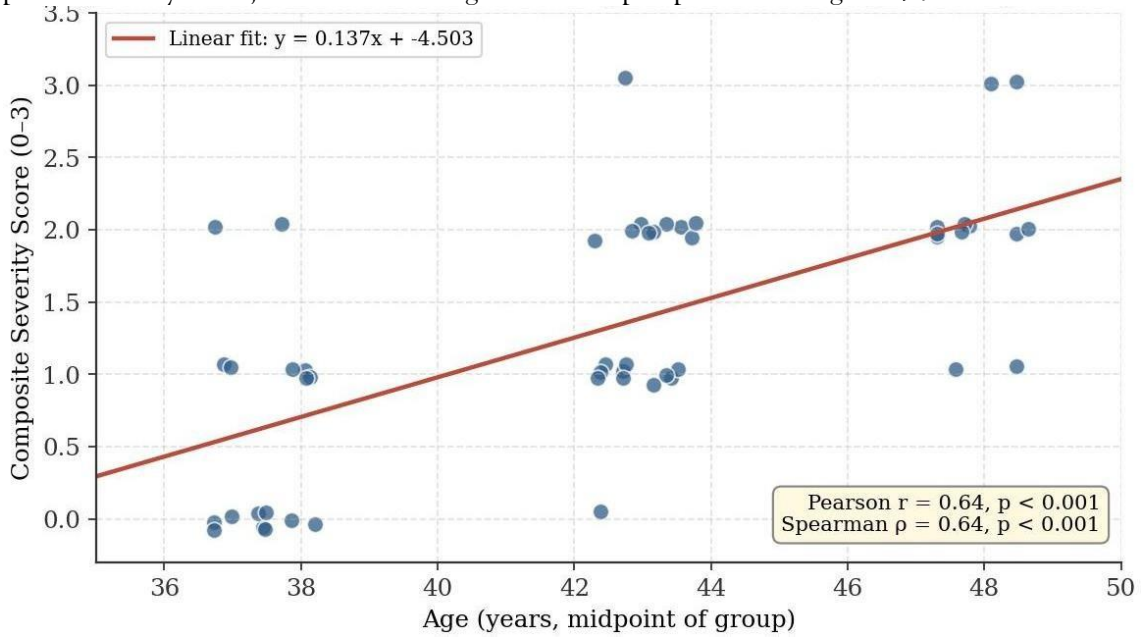

Figure 4.7: Correlation between patient age and shoulder joint degeneration severity

Parametric and non-parametric correlation methods told the same story. The Pearson product-moment correlation came out at $r = 0.639$ ($p < 0.001$), and the Spearman rank-order correlation at $\rho = 0.638$ ($p < 0.001$). By conventional interpretation (Cohen, 1988), a coefficient around 0.6 represents a strong positive correlation. In practical terms, as age increases, the severity of shoulder joint degeneration rises in a fairly consistent manner.The linear trend line in Figure 4.7 has a

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positive slope of roughly 0.14 severity units per year of age. In practical terms, this equates to about a one-grade rise in composite severity for every seven-year increase in patient age, within the 35 to 50 year window of this study. The ordinal nature of the scoring limits how strictly the slope can be interpreted, but the Spearman result which makes no distributional assumptions confirms the same strong monotonic pattern.

Table: Pearson Correlation

Variables Compared	Pearson Correlation (r)	p-value	Interpretation
Age vs Severity	0.639	<0.001	Strong positive correlation

Table: Spearman Correlation

Variables Compared	Spearman Correlation (ρ)	p-value	Interpretation
Age vs Severity	0.638	<0.001	Strong Positive correlation

This outcome sits comfortably alongside the chi-square and ANOVA findings and together they make a consistent statistical case: advancing age is strongly and independently tied to the severity of radiographic shoulder joint changes in patients with coexisting diabetes and hypertension.

4.8 Summary of Key Findings

The statistical analysis produced the following key findings:

- A strikingly high overall prevalence of radiographic shoulder joint abnormalities — 80.0% — in older adults carrying both diabetes and hypertension.
- Restricted shoulder mobility (26.0%) and joint space narrowing (24.0%) were the leading abnormalities, followed by osteophyte formation and bone deformity (each 12.0%), with subchondral sclerosis trailing at 6.0%.
- Grade 3 moderate severity was the dominant grade across most parameters, indicating that intermediate-stage degeneration accounted for the bulk of affected patients.
- A statistically significant association between advancing age and the presence of radiographic abnormalities ($\chi^2 = 17.58$, df = 2, $p < 0.001$); abnormal findings climbed from 47.1% in the 35–40 year group to 100.0% in the 46–50 year group.
- A one-way ANOVA confirmed that mean composite severity differed significantly across the three age groups ($F(2, 47) = 16.67$, $p < 0.001$, $\eta^2 = 0.415$), consistent with a large effect of age on

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severity.

- Correlation analysis demonstrated a strong positive relationship between age and shoulder joint severity (Pearson r = 0.639, $p < 0.001$; Spearman $\rho = 0.638$, $p < 0.001$).
- A clear shift in the pattern of degenerative findings with age: early changes such as joint space narrowing dominated in younger patients, while advanced changes like bone deformity took over in the oldest group.
- The overall radiographic impression placed 74.0% of patients within the mild-to-moderate range, 6.0% in the severe range and 20.0% as normal, reinforcing the need for early radiographic screening in this at-risk group.
- Taken as a whole, the data make a clear case: conventional X-ray offers an accessible and clinically practical way to detect both early and progressive shoulder changes in this patient population.
- The strong age trend, confirmed by three separate statistical tests (chi-square, ANOVA and correlation), supports routine musculoskeletal screening from the early forties onwards in patients living with both diabetes and hypertension.

DISCUSSION

The present cross-sectional radiographic study analysed deteriorating alterations in the shoulder joint patients with simultaneous diabetes and hypertension. The detection showed a high incidence of radiographic abnormalities, with 80% of people showing one deteriorating feature and only 20% continuing to have normal radiographs. These findings support the developing documentation that metabolic and vascular disorders considerably support musculoskeletal deteriorating, weight-bearing and highly moveable joints such as shoulders. A key surveillance study is the most deteriorating alteration, mild to moderate in severity (74%), with severe cases being relatively joint amongst patients with simultaneous diabetes mellitus (DM) and hypertension (HTN). The findings show a high frequency of radiographic abnormalities, with 80% of contributions showing at least one deteriorating uncommon (6%). This aligns with existing literature recommending that joint deterioration in patients with DM and HTN often tactfully advances by degree. Studies reviewed in the literature portion show advanced alterations such as joint space narrowing and osteophyte-induced severe structural distortions. In the same way, the present study found that joint space narrowing (24%) and limited movements (26%) are the most regular findings, supporting previous testimony that early deteriorating signs are more common than advanced pathology. Relationship with present literature: first, the study findings are consistent with previous research showing that diabetes mellitus is strongly correlated with musculoskeletal deterioration, exceptionally through mechanisms such as aggregation of advanced glycation end- products (AGEs) and collagen stiffening. Literature recommended that diabetic patients reveal increased joint stiffness and capsular thickening, leading to limited movement and early deteriorating changes. The recent study supports limited shoulder movement appearing as the most recurrent abnormality (26%), reflecting similar patterns reported in earlier studies.

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Second, the role of hypertension as a providing factor is also supported by the literature. Previous studies have shown that vascular inadequacy and low tissue circulation in hypertensive patients impair healing and accelerate joint deteriorating. The current findings align, as the deteriorating changes were widely prevalent among patients with combined diabetes mellitus and hypertension. Some earlier studies showed that hypertension alone may not be a numerically significant independent risk factor, but it acts as a changer. This study indirectly supports that point of view, focusing on combined disease conditions rather than segregating hypertension as a single variable. Third, the age-related development of deterioration observed in this study strongly agrees with present research. The results show a numerically major relationship between age and both the presence and severity of deteriorating changes ($p < 0.001$). The proportion of abnormal findings increased drastically from 47.1% in the 35–40 age group to 100% in the 46–50 age group. This trend mirrors earlier studies that identify ageing as a major risk factor due to reduced regenerative capabilities and accumulation of biomechanical stress. Points of Contrast with Existing Literature Despite these similarities, several contrasts with present literature are notable. First, while previous studies often report a strong connection between diabetes and rotator cuff tears or adhesive capsulitis, the current study mainly identified radiographic bony changes such as joint space narrowing and osteophytes. This difference may be due to the use of plain radiography, which is less sensitive for soft tissue abnormalities as compared to MRI or ultrasonography. The absence of comprehensively soft tissue findings in this study contrasts with literature that emphasises tendon and capsular pathology. Second, some studies suggested that osteophyte formation is the dominant radiographic feature in deteriorating shoulder disease. In the present study, osteophytes were observed in only 12% of cases, making them less common compared to movement limitation and joint space narrowing. This variance may reflect differences in study population, disease duration, or the relatively younger age range (35–50 years) included in this research. Third, literature often highlights subchondral sclerosis as a frequent late-stage finding; in this study it was the least common abnormality (6%). This suggested that the study population mainly displayed early to middle stages of degeneration rather than advanced osteoarthritis. It may also indicate that radiographic detection of subchondral changes is less sensitive in early disease phases. understanding of key finding The superiority of mild-to-moderate degenerative changes suggested that most patients were identified at an early stage of disease advancement, which is clinically significant. Early-stage detection provides a chance for intervention through lifestyle modification, physiotherapy, and medical management, possibly preventing progression to severe disability. The strong positive correlation between age and severity ($r \approx 0.64$) further emphasises the increasing impact of metabolic and vascular dysfunction over time. The study demonstrates that degeneration is not only more widespread but also more severe in older individuals, highlighting the importance of early screening in middle-aged patients with DM and HTN. Another important finding is the variation in radiographic features across age groups. Younger patients (35–40 years) predominantly showed early changes such as joint space narrowing, while older patients (46–50 years) exhibited more advanced features like bone deformity. This progression pattern supports the theory of a

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gradual degenerative cascade, beginning with cartilage loss and culminating in structural deformity. Clinical applications The study underscores the importance of routine radiographic screening in patients with diabetes and hypertension, especially as they age. Plain radiography, despite its limitations, proved to be a valuable, accessible, and cost-effective tool for detecting early degenerative changes.

This is particularly relevant in resource-limited settings where advanced imaging modalities may not be readily available. Furthermore, the findings highlight the need for a cross-sectional approach involving radiologists, physicians, and physiotherapists. Early identification of degenerative changes can guide timely interventions such as glycaemic control, blood pressure management, and rehabilitative therapy. Limitations of the study: This study has several limitations. The use of a convenience sampling technique and relatively small sample size (n=50) may limit generalisability. Additionally, the reliance on plain radiography restricts the ability to assess soft tissue abnormalities, which are commonly associated with diabetic shoulder conditions. The cross-sectional design also prevents establishing relationships between diabetes mellitus and hypertension and joint degeneration. Future studies should incorporate larger sample sizes, longitudinal designs, and advanced imaging modalities such as MRI to provide a more comprehensive assessment.

CHAPTER 6: CONCLUSION

This study demonstrated that deteriorating changes in the shoulder joint are highly widespread among patients with simultaneous diabetes mellitus and hypertension, with 80% of individuals showing radiographic abnormalities. The majority of these changes were mild to moderate in severity, indicating early-stage disease in most patients. The 46–50 age group had the most problems, with 100% of them showing signs of problems. The main results showed that people between the ages of 41 and 45 had frozen shoulders and smaller joint gaps. When they were 46 to 50, bone deformation and a big loss of mobility were typical. The findings support existing literature that metabolic and vascular disorders accelerate musculoskeletal degeneration; differences were noticed in the frequency of specific radiographic features. Overall, the study highlights the clinical importance of early radiographic screening and combined management strategy in patients with chronic systemic diseases to prevent progression to severe disability and improve quality of life.

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