Update Article

Osteoarthritis

A Mahajan+, S Verma+, V Tandon*

Abstract

Osteoarthritis (OA) is a chronic degenerative disorder of multifactorial etiology characterized by loss of articular cartilage and periarticular bone remodelling. OA causes joint pain, typically worse with weight-bearing and activity as well as can manifest with stiffness after inactivity. It can present as localized, generalized or as erosive osteoarthritis. Primary osteoarthritis is mostly related to aging, whereas, secondary osteoarthritis is caused by another disease or condition. X-rays, arthrocentesis and arthroscopy remain the main diagnostic tools. Blood tests are performed to exclude diseases that can cause secondary osteoarthritis. The treatment of osteoarthritis includes non-pharmacological management, pharmacological treatment in the form of drugs which can modify symptoms, symptomatic slow acting drugs for OA or structure modifying OA drugs depending upon the clinical requirement of the patient. Patients with persistent pain and progressive limitation of daily activities despite medical management may be the candidates for surgery. ©

INTRODUCTION

Osteoarthritis (OA) is a chronic degenerative disorder of multifactorial etiology characterized by loss of articular cartilage, hypertrophy of bone at the margins, subchondral sclerosis and range of biochemical and morphological alterations of the synovial membrane and joint capsule. Pathological changes in the late stage of OA include softening, ulceration and focal disintegration of the articular cartilage; synovial inflammation also may occur. Typical clinical symptoms are pain, particularly after prolonged activity and weight bearing; whereas stiffness is experienced after inactivity.[1] It is probably not a single disease but represents the final end result of various disorders as joint failure. It is also known as degenerative arthritis, which commonly affects the hands, feet, spine, and large weight-bearing joints, such as the hips and knees. Most cases of osteoarthritis have no known cause and are referred to as primary osteoarthritis. Primary osteoarthritis is mostly related to aging. It can present as localized, generalized or as erosive osteoarthritis. Secondary osteoarthritis is caused by another disease or condition.[1] Osteoarthritis (OA) is the second most common rheumatological problem and is most frequent joint disease with prevalence of 22% to 39% in India.[2-4] This is the most common cause of locomotor disability in the elderly.[5] Gastrointestinal toxicity is present in 50% of NSAIDs users and 5.4% develop a more serious event requiring hospitalisation due to its frequent use. There use may have a significant impact on overall cost of therapy in patients of OA in spite the fact that NSAIDs are not very costly.[6,7] Hence, OA represents a major cause of morbidity and disability, as well as a significant economic burden on patients and health care resources.[8] The article reviews different aspects of OA with an emphasis on early treatment with different modalities to minimize the major physical, mental, social and economic trauma.

+Post Graduate Department of Medicine; *Post Graduate Department of Pharmacology and Therapeutics; Government Medical College, Jammu (J and K) India - 180 001.
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CLASSIFICATION[9]

1) Primary osteoarthritis (idiopathic)

A. Localised
- – Hands – nodal osteoarthritis more than three joints involved
- – Hip – eccentric, concentric, diffuse
- – Knee – medial tibiofemoral, lateral tibiofemoral, pattelofemoral
- – Spine – apophyseal, intervertebral, spondylosis

B. Generalised
1. Small (peripheral) joints
2. Large (central) joints
3. Mixed and spine

C. Erosive osteoarthritis

2) Secondary
- i) Congenital and developmental disorders, bone dysplasias.
- ii) Post-surgery / injury – meniscectomy.
- iii) Endocrine – diabetes mellitus, acromegaly, hypothyroidism, hyperthyroidism, hyperparathyroidism, Cushing syndrome.
- iv) Metabolic – hemachromatosis, ochronosis, Marfan syndrome, Ehler-Danlos syndrome, Paget disease, gout, pseudogout, Wilson's disease, Hurler disease, Gaucher disease.
- v) Rheumatologic– rheumatoid arthritis.
- vi) Neurological– Charcot joints.

vii) Hematological – hemoglobinopathies.
viii) Iatrogenic – intra-articular steroids.

ETIOLOGY

Exact etiology is unknown and multiple factors interact to cause this disorder.

Age : Although advance osteoarthritis may occur in many young people in early 20's, the frequency of condition escalates markedly in advancing years. Furthermore, older people are found to have rapid radiological progression of osteoarthritis.[5,10]

Sex : The Framingham Knee Osteoarthritis study suggests that knee osteoarthritis increases in prevalence throughout the elderly years, more so in women than in men.[11] Females are found to have more severe OA, more number of joints are involved, and have more symptoms and increased hand and knee OA.[12] These observations and others reporting a painful form of hand osteoarthritis after the menopause suggest that loss of estrogen at the time of menopause increases a woman's risk of getting osteoarthritis,[13] however few contrary reports are pouring in.[14]

Obesity : Obesity preceeds rather than follow knee osteoarthritis and indeed weight loss prevents development of knee osteoarthritis.[15]

Genetic : Hip osteoarthritis has a significant genetic component.[16] Nodal generalised osteoarthritis is a polyarticular form of osteoarthritis characterized by Heberden's nodes occurring mainly in women of perimenopausal age. Heberden's nodes appear to be inherited independently as an autosomal dominant trait with greater penetrance in women.[17] In 1990, Knowlton *et al*[18] reported a non-glycine, second position, autosomal dominant Arg-Cys mutation of COL2A1 in an American family with inherited generalized OA and minor chondrodysplasia. COL2A1 and vitamin D receptor gene polymorphism may also be included within genetic risk profile.[19]

Bone density : Negative association has been reported between osteoporosis and osteoarthritis at certain sites particularly the hip.[20]

Cigarette smoking : Protective influence of smoking on knee osteoarthritis has been reported from various studies including Framingham study.[21]

Local factors : Major direct injury particularly if resulting in a fracture of articular surface is considered a cause of osteoarthritis.[22] Trauma in college years (mean age 22) increases subsequent prevalence of osteoarthritis in subjects in their 60's.[23]

Joint location : OA is more common in hip and knee joint but occur rarely in ankle. Alteration in chondrocyte responsiveness to different cytokines may be the reason eg. knee chondrocytes exhibit more IL-1 receptors than ankle chondrocytes and knee chondrocytes express mRNA for matrix MMP-8.[1]

Other : Chondrocalcinosis,[10] crystals in joint fluid / cartilage, prolonged immobilization, joint hypermobility or instability, peripheral neuropathy, prolonged occupational or sports stress are the important risk factors for the causation of OA.[24]

PATHOGENESIS[1,17]

Although the etiology of OA is incompletely understood, the accompanying biochemical, structural and metabolic changes in the joint cartilage has been well documented**.** It is now known that cytokines, mechanical trauma and altered genetics are involved in pathogenesis and that these factors can initiate a degenerative cascade that results in many characteristic alterations in the articular cartilage in OA. Normal hyaline cartilage is composed of chondrocytes embedded in extracellular matrix which in turn is constituted by water, type II collagen and proteoglycan. The cartilage remains stable with active degeneration and regeneration occurring in equilibrium. Whatever is the triggering event, it leads to matrix and cartilage degeneration on one hand and active chondrocyte replication with enhanced biosynthesis on the other hand. This leads to a state of homeostasis, known as compensated OA, in which both repair and degeneration are balanced. After a few years, the reparative process is exhausted. This leaves cartilage degradation unopposed leading to progressive OA. More recently it has become apparent that OA is a disease process that affects the entire joint structure, including cartilage, synovial membrane, subchondral bone, ligaments and periarticular muscles**.** This ultimately results into inflammation, pain and structural damage leading to loss of function (Fig. 1).

The structural changes, metabolic, biochemical changes in osteoarthritis cartilage and role of growth factors and cytokines in the pathogenesis of OA is depicted below.

Structural changes[17] : Mainly are reductions in stainable proteoglycan, fibrillation, collagen crumping, chondrocyte multiplication or migration and loss of cartilage. Initially, localized areas of softening present a pebbled texture at surface followed by disruption along collagen fiber planes (tangential flaking, vertical fibrillation). As deep clefts are formed in cartilage, nearby matrix gets depleted of metachromatic material indicating loss of proteoglycans. Subsequent focal proliferation of chondrocytes occurs as an attempt at local self-repair leading to irregularly shaped hyaline and fibro cartilage. Later new bone formation occurs in subchondral bone and at joint margins (osteophytes). Subarticular cysts predominate wherever overlying cartilage is thin or absent. Separated fragments of cartilage and bone may form loose bodies, undergo dissolution or become incorporated into synovium and proliferate locally. Synovium becomes thick and

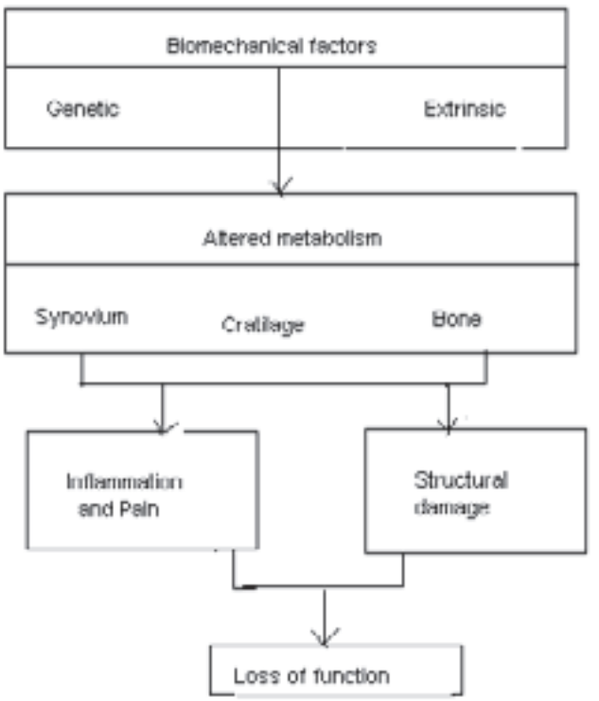

Fig. 1

hypertrophied and capsule contracts with infiltration of lymphoid follicles, lymphocytes and macrophages. Calcification may occur as calcium crystals deposit in cartilage with presumed secondary uptake in synovium. Despite loss of bone and cartilage in some parts of joint, net effect of new cartilage and bone formation is an increase in joint size and remodelling of shape.

Metabolic and biochemical changes in osteoarthritis cartilage[1,17]

- Generalised – Increased hydration and swelling with loss of tensile strength is noticed in early OA, whereas increase in type I collagen synthesis and progressive fall occurs in proteoglycan concentration in later stage of OA.
- Specific collagens – Initial swelling of collagen fibrillar network with loss of type II collagen, specific cleavage of collagens and loss of tensile strength with increased content of collagen type IV. Type III and X collagen are also synthesized.
- Proteoglycans – Increased extractability and decrease in monomer size because of specific cleavages by aggrecanases and metalloproteinases.
- Cytokines, proteinases and inhibitors – There is increase in pro-inflammatory cytokines, aggrecanases, MMPs (matrix metalloproteinase), cathepsins and decrease in overall inhibitors (TIMP etc.).

Of the three major MMPs (1, 8, and 13) that degrade native collagen, MMPs -13 is most important, as it preferentially degrades type II collagen whose expression is greatly increased in OA. The aggrecanases belong to a family of extracellular proteases known as disintegrin and metalloproteases with thrombospondin motifs (ADAMTS). ADAMTS-4 and ADAMTS-5 appear to be major enzymes in cartilage degeneration in arthritis. Where as, IL-1beta synthesized by mononuclear cells (including synovial cells) in inflamed joint is considered by many investigators as a prime mediator in cartilage matrix degradation and stimulates synthesis and secretion of many degradative enzymes in cartilage including latent collagenase, stronelysin, gelatinase and tissue plasminogen activator.

The balance of active and latent enzymes is controlled to some extent by at least two enzyme inhibitors: TIMP and plasminogen activator inhibitor-1(PAT-1).Which in turn are reglated by TGF-beta. However, the imbalance between proteoglycan synthesis and degradation is important in pathogenesis of cartilage breakdown.

Growth Factors and Cytokines[1,17]

Anabolic

— TGF (tissue growth factor beta-$_{1, 2 \& 3}$) help in chondrocyte proliferation, matrix synthesis, modulate effects of IL-1 and increases proteinase inhibitors.

— Fibroblast and platelet derived growth factors also help in differentiation and proliferation of chondrocytes and MMP production.

— Insulin growth factor-1(IGF-1) increases glycosaminoglycan (GAG) and collagen synthesis.

— Bone morphogenetic proteins increase matrix synthesis.

Catabolic

— Interleukin-I (IL-1) and tumor necrosis factor (TNF-a) increase MMPs, inhibit GAG synthesis and can further potentiate the degenerative cascade.

— Oncostatin-M combines with IL-1 and TNF to promote matrix breakdown.

— Others like IL-17 and IL-18 increase expression of IL-1bð and IL-6 and increase MMP.

— NO (nitric oxide) is a major catabolic factor produced by chondrocytes in response to proinflammatory cytokines such as IL-I beta and TNF-alpha. NO can inhibit collagen and proteoglycan synthesis, can activate MMPs and cause an oxidative injury as well as produce apoptosis leading to degradation of articular cartilage.

— Prostaglandins effects on chondrocytes metabolism are complex and include enhanced type II collagen synthesis, activation of MMPs, and promotion of apoptosis. In cartilage explants, IL-1beta induces COX-2 expression and PGE_2 production coordinate with proteoglycan degradation. Moreover, COX-2 inhibition prevents IL-1beta induced proteoglycan degradation.

Regulatory

— IL-6 increases proteinase inhibitors production and proliferation of chondrocytes while IL-4, IL-13 and interferon ^{3} oppose effects of proinflammatory cytokines.

— IL-1 receptor antagonist blocks effect of IL-1.

Clinical Features[1,10,17]

Symptoms **:** Pain is the chief complaint. This is due to stimulation of capsular pain fibers, mechanoreceptors (increased intra-articular pressure due to synovial hypertrophy), periosteal nerve fibers and by perception of subchondral microfractures or painful entheses and bursae. Stiffness is other complaint described as gelling of joint after inactivity with difference in initiating movement. Some patients may complain of joint swelling and deformity and coarse crepitus.

Signs **:** Coarse crepitus, due to irregularity of articular surface, bony enlargement due to remodelling and osteophytes, deformity, instability, restricted ability and stress pain.

Nodal generalized osteoarthritis **:** Present commonly as polyarticular, finger I-P joint involvement, Heberden (distal I-P joint) and Bouchard (proximal I-P joint) nodes. There is female predominance peaking around menopause and marked familial predisposition. Typically patient is a woman aged 40-60 years developing discomfort followed by swelling of single finger inter-phalangeal joint, later involving another I-P joint within few months and then another producing stuttering onset of polyarthritis of distal and proximal I-P joints.

Erosive osteoarthritis **:** Uncommon variety, with hand I-P joint involvement, inflammatory signs, erosion in subchondral regions in radiography and tendency for ankylosis of I-P joints. Subchondral erosive change may lead to 'Gull's wing' as remodelling occurs.

Large joint osteoarthritis

Knee **:** Most commonly affected by osteoarthritis, usually bilateral, often occurs in association with hand osteoarthritis especially in women.[25,26] Invariably focal with principal sites involved being (i) medial tibiofemoral compartment with severe bone and cartilage attrition at this site resulting in various deformities; (ii) patellofemoral compartment (lateral > medial) because of its intimate relationship with the quadriceps mechanism leading to greater functional impairment.[27]

Hip **:** Superior pole osteoarthritis is commonest with focal cartilage and loss in superior part of joint. Osteophyte formations are prominent at lateral acetabular and medial femoral margins with thickening of cortex of medial femoral neck by periosteal osteophytes. Central medial osteoarthritis is less common, with more central joint space loss with less femoral neck buttressing. More associated with nodal osteoarthritis.

Table 1

Classification criteria for osteoarthritis of the hip
Traditional format
Hip pain plus at least two of the following
ESR of less than 20 mm per hour
Femoral or acetabular osteophytes on radiographs
Joint space narrowing on radiographs (superior, axial and or medial)
Classification-Tree format
Hip pain plus femoral or acetabular osteophytes on radiographs *or*
Hip pain plus joint space narrowing on radiographs and an ESR of less than 20 mm per hour.[28]
Classification criteria for idiopathic osteoarthritis of the knee
Traditional format
Knee pain plus osteophytes on radiographs and at least one of the following
Age more than 50 years
Morning stiffness lasting 30 minutes or less
Crepitus on motion
Classification-Tree format
Knee pain and osteophytes on radiographs *or*
Knee pain plus patient age of 40 years or older,
Morning stiffness lasting less than 30 minutes and crepitus on motion.[29]
Classification criteria for osteoarthritis of the hand
Hand pain, aching or stiffness *plus*
Hard tissue enlargement of two or more of 10 selected joints *Plus*
Fewer than three swollen metacarpophalangeal joints *Plus*
Hard tissue enlargement of two or more distal interphalangeal joints *or*
Deformity of two or more of 10 selected joints.[30]
(10 selective joints are 2nd and 3rd DIP joint, 2nd and 3rd PIP joint and 1st carpo-metacarpal joint of both hands)

Osteoarthritis at other joint sites

Osteoarthritis of spinal apophyseal joints (lower cervical and lower lumbar segments), first carpometacarpal and/or first metatarsophalangeal joints is common and may occur as a part of pattern of generalised osteoarthritis or as an isolated feature (Table 1).

The diagnosis of OA is essentially clinico-radiological.

Investigations

X-rays are still the main diagnostic tool however arthroscopy, ultrasound, MRI, CT scan etc. are used specially for experimental studies and not recommended for routine clinical use. Plain radiographs can show joint space narrowing, osteophytes, sclerosis and subchondral radioluscencies.[31,32] Other features like effusions, loose bodies, joint alignment, subluxation, chondrocalcinosis, collapse due to avascular necrosis are also noticed. Modified radiographic techniques with higher magnification and resolution may detect early subchondral bone abnormalities by stereoscope

reconstruction.[33] Radionucleide studies may detect abnormalities before radiographic signs are identified. Arthrocentesis and laboratory testing may help identify an underlying cause of secondary OA.

Radiological findings of specific joints[10]

Hand : Single postero-anterior view is satisfactory. Bone sclerosis, focal narrowing and lateral subluxation accompanied by erosions and in case of erosive osteoarthritis, all changes of osteoarthritis plus subchondral bone erosion-gullwing appearance may be noticed.

Knee :

Views –

A. Standing anteroposterior (weight-bearing).
B. Lateral.
C. Notch patellar views (sunrise view)
    1. Posteroanterior intracondylar (PAIC)
    2. Tangential patellar

Findings –

A. Joint space narrowing
    1. Medial tibiofemoral joint space narrowing
    2. Patellofemoral joint space narrowing
    3. Lateral joint space narrowing to lesser extent
B. New subchondral bone formation
C. Tibia lateral subluxation
D. Medial osteophytes formation is most prominent initially

Hip : Single non-weight bearing A-P view of pelvis is usually satisfactory and has advantages of incorporating both hips on same radiograph.

Sacroiliac joint

Osteophyte and joint space loss may need to be distinguished from inflammatory sacroiliitis. Osteoarthritis causes more focal space narrowing and sclerosis with overlying osteophytes, usually anterosuperior/inferior and is identified by discontinuity of trabecular lines across joint.

Foot : Posteroanterior radiograph of foot.

Spine : More in lower cervical and lumbar spine and may also in facet joints (cervical region). Lateral, A-P lumbosacral and cervical views are appropriate.

Management Of Osteoarthritis

Goals of managing osteoarthritis include controlling pain, maintaining and improving range of movement and stability of affected joints and limiting functional impairment .[34]

Non-pharmacological Management

Education, behavioral intervention, weight loss, lower extremity strengthening exercise for 20-30 minutes per day, quadriceps strengthening, gait training, active range of motion of hip, knee and ankle, instructions in use of cane, graded elastic band use and pool therapy are modestly effective in reducing pain and disability.[35] Mechanical aids in the form of shock-absorbing footwear with good mediolateral support, adequate arch support and calcaneal cushion are also helpful. Lateral heel wedges may reduce pain related to osteoarthritis of medial tibiofemoral compartment[36] and applying adhesive tapes to patella can provide relief in patellofemoral osteoarthritis.[37]

Pharmacological Management

I. Symptom modifying drugs

Acetaminophen is often effective in osteoarthritis, associated with fewer adverse reactions than NSAIDs and is recommended as initial therapy for osteoarthritis in addition to non-pharmacological interventions.[38] Salicylates and traditional NSAIDs are considered only for patients who do not obtain adequate pain relief with paracetamol.[39] COX-2 inhibitors can be considered for use because of better gastrointestinal tolerability. Celecoxib, etoricoxib in the dose of 60 mg/day and valdecoxib 10mg/day are as efficacious as non-selective NSAIDs in pain relief.[40,41] However recent studies are challenging the cardiovascular safety of COX-2 inhibitors.[42] Misoprostol as co- therapy in selective patients requiring chronic NSAIDs treatment may help to prevent gastric ulcers.[43]

Opioids (codeine) and paracetamol in combination provide better analgesia than paracetamol alone.[44] Treatment with tramadol results in statistically significant and clinically important and sustained improvement in pain, stiffness, physical function, global status and sleep in patients with chronic pain.[45] Tramadol 37.5 mg / Acetaminophen 325 mg combination is also effective and safe for treatment of osteoarthritis pain.[46] Topical analgesics (0.025% capsaicin cream [47] and other local NSAIDs[1]) have been considered appropriate as an adjunct to simple analgesia, monotherapy for a single symptomatic joint or for patients who cannot tolerate systemic therapy. The mechanism of action of capsaicin is thought to be through selective stimulation of unmyelinated type C afferent neurons, causing the release of substance P. Such a release reversibly depletes the store of substance P, a neurotransmitter of peripheral pain sensation.[1]

In general, intra-articular corticosteroid injections are believed to be most effective in patients with evidence of inflammation, effusion, or both. Because of concerns over possible deleterious effects, usually no more than four corticosteroid injections per year are given in a particular joint.[1] Intra-articular glucocorticoid injection, afford moderate and short-lived reduction in pain.[48] Triamcolone hexacetonide (TH) suspension is a relatively long acting corticosteroid commonly used for

IA injection.[49] Patients presenting with significant inflammation with demonstrable CPPD crystals in joint have better symptomatic relief with colchicine.[50]

II. Symptomatic slow acting drugs for OA (SYSADOA)

Hyaluronic acid (HA) is a linear polysaccharide composed of repeating disaccharide units of N-acetyl glucosamine and D-glucoronic acid. Two of these agents- hyalgan and synvis- are approved for viscosupplementation in the United States for use in OA of the knee. Multiple injections spaced 1 week apart provide reduction in pain and beneficial effect lasts for upto 6 months, much longer than as compared to intraarticular steroids. Synvisc requires three injections per course of treatment, whereas hyalgan requires five. They are often mentioned as potential structure modifying agents but are presently considered as symptom-modifying drugs only. There is an evidence for an anti-inflammatory effect, a short-term lubricant effect, an analgesic effect by directly buffering of synovial nerve endings and a stimulating effect on synovial lining cells leading to production of normal hyaluronic acid.[1] The therapeutic benefit of its multiple intraarticular injections may be comparable to that of NSAIDs.[51] Hylan GF-20 (synvisc) is a high molecular weight cross-linked derivative of hyaluronan that has elastoviscous properties similar to healthy synovial fluid. Its efficacy for treatment of osteoarthritis knee pain, with low incidence of local adverse effects, has been demonstrated in different clinical trials.[52] Hyaluronic acid products are also being actively investigated in shoulder joint OA, periarthritis and adhesive capsulitis.[1]

***Nutraceuticals*:** Pair of nutritional supplements, namely glucosamine sulphate and chondroitin sulphate has received significant attention. Glucosamine sulphate is a derivative of the naturally occurring amino monosaccharide glucosamine, a constituent of glycosaminoglycan chain in aggrecans and other proteoglycans found in synovial fluid and cartilage of joints. It is a substrate for synthesis of mucopolysaccharides and there is latency of 4-8 weeks before therapeutic effect emerges.[53] Two randomized, controlled, double blind trials in Belgium[54] and Czech Republic[55] suggested that this drug (1.5 g daily) has a substantial symptom and structure modifying effect in patients with mild to moderate osteoarthritis of knee.

Chondroitin sulphate similarly provides additional substrates for formation of healthy joint matrix. Evidence also supports oral administration of chondroitin sulphate to slowly reduce symptoms and to reduce need for NSAIDs.[56] It ameliorates the symptoms of osteoarthritis, though this effect only occurs after longer period of time.[57] Chondroitin has been found to be effective on Lequesne index,and visual analog scale. Mobility and responding status is also excellent (800 mg / day).[58] Combined use of glucosamine sulphate and chondroitin sulphate in treatment of degenerative joint disease has become an extremely popular supplementation protocol in OA.[59]

Other drugs[1] in this category are ginger extract, which actually contain salicylate and has inhibitory effect on COX and lipooxygenase. Similarly oral preparations of avocado and soy unsaponifiables (ASU) have been shown in vitro to inhibit IL-6, IL-8, MMPs and stimulate collagen synthesis. Cat's claw and shark cartilage treatment leads to an improvement in symptoms of OA, as they also contain chondroitin sulphate. Most recently another compound (S- Adenosyl methionine), an oxygen radical scavenger has been shown to reduce pain in OA but still larger trials are awaited.

III. Structure modifying OA drugs (SMOADS) / chondroprotective[1,10]

Tetracyclines are inhibitors of tissue metalloproteinases. This could be due to their ability to chelate calcium and zinc ions. Minocycline and doxycycline have been shown to inhibit articular cartilage collagenase activity, prevent proteoglycan cell loss, cell death and deposition of type X-collagen matrix. Glycosaminoglycan polysulfuric acid (GAGPS), known as arteparon, work through reducing the collagenase activity and has shown promising results. Similarly other agents like glycosaminoglycan peptide complex (GC-P) known as rumalon has shown to increase the levels of tissue inhibitors of metalloproteinase, while pentosan polysulfate (cartrofen) inhibits granulocyte elastase. However, larger clinical trials have yet to prove their structure modifying activity. Diancerin and its active metabolite rhein has the capability to inhibit IL-I beta in human synovium. It has improved pain score in patients of OA as well as it has been proposed as structure modifying drug for OA. Moreover disease modification potential of agents like glucosamine, hyaluronan, growth factors and cytokine manipulation, gene therapy as well as chondrocyte and stem cell transplant needs further evaluation.

Other : Various other therapies include transcutaneous nerve stimulation, local massage, thermal modalities, acupuncture, amitriptyline, pain management counseling and support groups. Assistive devices in knee osteoarthritis, physical therapy in form of knee sleeves, cane or walker and occupational therapy are modalities, which can be very useful.[1,10]

Surgery : Patients with persistent pain and progressive limitation of daily activities despite medical management may be referred for surgical intervention to an orthopedic surgeon.[60]

In conclusion, the treatment of OA includes a variety of possible non-pharmacological, pharmacological and surgical interventions. Treatment should be tailored to individual and will consist of a combination of available modalities.

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