SYMPOSIUM I

Spine Structure and Function

Spine Biomechanics for Clinicians

Keynote Address

Manohar M Panjabi
Departments of Orthopedics & Rehabilitation, and Mechanical Engineering
Yale University, New Haven, CT, USA

Chronic low back pain (CLBP) is a worldwide problem seriously affecting both patients and societies. Through the life span approximately 80% individuals suffer from low back pain. At any point of time 10–18% population demonstrate symptoms of CLBP, incurring a huge cost burden amounting to 100-200 USD per year (Andersson. Lancet 1999, Crow. JAOA 2009). Despite the high socioeconomic burden and functional disability, current understanding of the origin of CLBP is poor, and, therefore, so is its diagnosis and treatment.

Biomechanics has contributed significantly to better understanding of spinal motions and loads, soft tissue injuries and fractures, and surgical and non-surgical treatments. Low back pain originating from specific anatomic sites—disc herniation, nerve root entrapment, etc., can be treated successfully via surgical intervention. However, majority of CLBP is non-specific in origin and is often presented as Clinical Spinal Instability (CSI). Knudsson (1944) was the first to describe CSI as the retro-displacement of a vertebral body during forward spinal flexion. White and Panjabi (1978) suggested another definition. A total flexion-extension ROM at L5 of > 20 degrees or translation of > 4.5 mm was sign of CSI. *In vivo* lumbar disc pressures were measured and resulted in recommendations for good ergonomics (Nachemson. Spine 1981). However, research focus returned to patients with CLBP when the problem became more severe in industrial countries and then soon spread to the developing countries. After countless biomechanical and clinical studies, we have a little better understanding of CLBP.

New CLBP hypotheses emphasized the role of spinal muscles and their precise dynamic actuation by neural control.[1, 2] The spinal stabilizing system (SSS) was conceptualized as has having three subsystems. Spinal column contains mechanoreceptors within the soft tissues. Spinal muscles contain tension receptors and produce forces. Neural control unit does the coordination. The SSS functions with the mechanoreceptors providing information regarding vertebral positions, motions and loads to the neural control unit which generates the needed dynamic muscles forces. Hundreds of small and large muscles are coordinated to dynamically stabilize each intervertebral joint in 3-dimensions without injury to the spinal system or the neural elements. The SSS may malfunction if there is an injury to the ligamentous mechano-receptors or muscle tension-receptors sending corrupted information to the neural control unit, resulting in high muscle forces and spasm, muscle fatigue, and high loads on facet joints, discs, end-plates. These higher forces may further injure the mechano- and tension-receptors, leading to the vicious cycle of tissue injuries, tissue inflammation, and CLBP.

There is some clinical evidence to support the SSS hypothesis. Numerous clinical studies report degradation of the neuro-muscular system in patients with CLBP. Large multi-segmental and small inter-segmental muscles have been found to be weaker (lower strength and endurance) with decreased cross-sectional areas, and fat infiltrations. Re-training exercises showed improvements in spinal function and decreased back pain.

Neutral Zone (NZ) was introduced as a new parameter to define CSI (Panjabi. J Spinal Disorders 1992). NZ is the intervertebral motion around the neutral posture with high laxity. Several *in vitro* studies have demonstrated that neutral zone increases due to ligament injury, vertebral trauma, disc degeneration. It decreases with application of simulated muscle forces, mechanical stabilization and surgical fusion. CSI as defined by NZ, is the decrease in capacity of the SSS to maintain intervertebral motions within the physiological limits. Recent studies have measured the NZ *in vivo* in patients undergoing surgery (Takano. AMB 2006, Hasegawa. JBJS 2011).

In conclusion, we have made progress in our understanding CLBP, an important societal problem, using tools of biomechanics and neuro-muscular analyses. The final solutions, for both understanding and interventions, however, remain elusive. Recommendations to manage CLBP need to emphasize prevention: Daily exercises to develop muscle strength, endurance and balance, and activities using sound ergonomics that decrease the lever arm and thus lower the spinal loads. CLBP is difficult to diagnose by imaging techniques, therefore, patient history and physical examination may be better tools.

REFERENCES

1. Panjabi MM. The stabilizing system of the spine. Part I and II. J Spinal Disord 1992 Dec;5(4):383–389 and 390–396, discussion 397.
2. Panjabi MM. A hypothesis of chronic back pain: Ligament sub-failure injuries lead to muscle control dysfunction. Eur Spine 2006;15(5):668–676.

Bone Health: A Clinician's Perspective

Priyank M Patel
Consultant Spine Surgeon
Lilavati Hospital and Research Center
Breach Candy Hospital
Mumbai 400026, Maharashtra, India.

Spine related consults are amongst the top three reasons for doctors' visit in the world. The spine (or the backbone) runs from the base of the skull to the pelvis. It serves as a pillar to support the body's weight and to protect the spinal cord. Bones of the spine are constantly undergoing change. New bone is being made and old bone is broken down. At a young age body makes new bone faster than it breaks, and bone mass increases. Most people reach their peak bone mass around age 30. After that, bone remodeling continues, but loss in bone mass is greater than gain. Hence, it is of utmost importance to maintain good bone health.

Factors affecting development of strong and healthy bones include:

- **Genetic abnormalities** which can produce weak, thin bones, or bones that are too dense.
- **Nutritional deficiencies** can result in the formation of weak, poorly mineralized bone.
- **Many hormonal disorders** can also affect bone formation.
- **Lack of exercise**, immobilization, and smoking can also have negative effects on bone mass and strength.

Osteoporosis is the most common bone disease.

Osteoporosis is a condition where the bone starts losing its density, becomes porous and susceptible to fractures. This may seem like a natural ageing phenomenon, however, unbalanced diet and inactivity are known to affect strength and density of bones because of which osteoporosis sets in. It affects every bone of the body; however, it is seen commonly in the hip, wrist, and spine.

Today, worldwide, osteoporosis causes more than 8.9 million fractures annually, resulting in an osteoporotic fracture every 3 seconds.[1] Osteoporosis is estimated to affect 200 million women worldwide—approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90.[2]

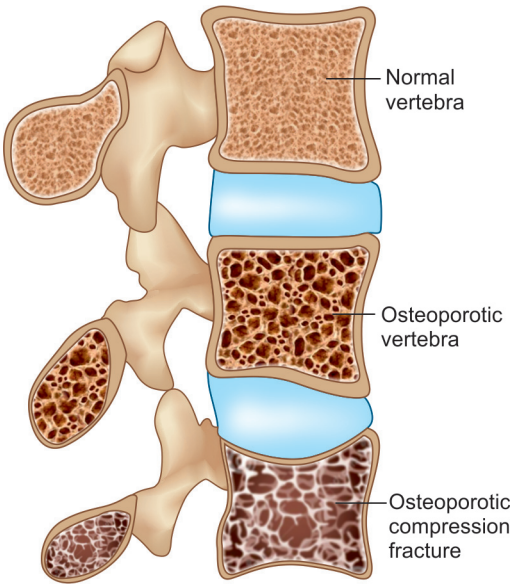


Fig. 1.1: Osteoprorosis

Osteoporosis takes huge personal and economic toll. In women over 45 years of age, osteoporosis accounts for more days spent in hospital than many other diseases, including diabetes, myocardial infarction and breast cancer. In men, the lifetime risk of experiencing an osteoporotic fracture over the age of 50 is up to 27%, higher than the lifetime risk of developing prostate cancer of 11.3%.

In a study among Indian women aged 30–60 years from low income groups, BMD at all the skeletal sites were much lower than values reported from developed countries, with a high prevalence of osteopenia (52%) and osteoporosis (29%) thought to be due to inadequate nutrition.[3]

In 2010 an international report in The Asian Audit, by the International Osteoporosis Foundation, had predicted that India would have approximately 36 million osteoporosis patients by 2013 but more serious was the fact that Indians are prone to fractures at a much younger age than their Western counterparts.

What are symptoms of osteoporosis?

Osteoporosis is a "silent disease" because bone loss occurs without symptoms. People are unaware of osteoporosis until a sudden strain, bump, trivial fall or heavy coughing/sneezing causes a bone to break. In fact, most of the times it is not noticed until the first fracture occurs.

Subtle signs of osteoporosis are sloping shoulders, curve in the back, loss of height, back pain, hunched posture and protruding abdomen.

Does osteoporosis affect men and women equally?

Women are at greater risk of osteoporosis; however, both men and women can be affected by it. In women, especially after menopause or hysterectomy, there is a gradual decline in ovarian function and a subsequent hormonal changes causing rapid loss of bone tissue. Rapid bone loss can occur at a rate of 2–5% in a year after menopause. Worldwide, 1 in 3 women over age 50 will experience osteoporotic fractures, as will 1 in 5 men aged over 50.[4]

What are the causes of osteoporosis?

There is no single cause for osteoporosis; however, there are certain risk factors which influence the development of osteoporosis.

A. *Non-modifiable Risk Factors*

Age—As age advances the chances of getting osteoporosis is higher.

Family history—Chances of getting osteoporosis is higher if any of the parents have it. This can explain why some people get osteoporosis early in life.

Gender—Females are at higher risk than men.

Ethnicity—Asian and Caucasian people are at higher risk than African/American people.

B. *Modifiable Risk Factors*

Lifestyle—Sedentary lifestyle or prolonged rest causes loss of bone and muscle mass.

Bad habits—Higher chances of osteoporosis is seen in patient consuming alcohol, tobacco or cigarette smoking, etc.

Medicines—continuous use of certain medications for chronic diseases like steroids, epilepsy medicines, etc. can cause osteoporosis.

Poor diet—less consumption of "raw materials" of bone formation like calcium or lack of vitamin D can lead to osteoporosis.

How is osteoporosis diagnosed?

The diagnosis of osteoporosis is not straightforward. It is a combination of complete medical history, physical examination, bone mineral density test (DEXA scan) and specialized laboratory test.

How likely you are to develop osteoporosis depends on how much bone mass you attain by the time you reach age 30 and how rapidly you lose it after that. The higher your peak bone mass, the more bone you have "in the bank" and the less likely you are to develop osteoporosis as you age.

How can we prevent osteoporosis, or halt its progression?

One can work on the modifiable risk factors to prevent osteoporosis. Theoretically one cannot halt the progression of osteoporosis, but can slow down the pace of deterioration. The best is to act fast, modify your lifestyle, get an osteoporosis screening done after 50, be vigilant for any early signs and if osteoporosis sets in, nip it in the bud with aggressive medical management.

What exercises are good for bone health?

Weight-bearing exercises that force you to work against gravity are good for bone growth. These include weight training, walking, jogging, climbing stairs, etc. If these are not possible due to pain, disabilities, etc. non-weight-bearing exercises like swimming or yoga can be taken up.

How do I modify my diet to get enough calcium and vitamin D?

1. **Calcium:** The National Academy of Sciences makes the following recommendations regarding daily intake of calcium.
   - Men and women aged 19 to 50 years: 1,000 mg per day
   - *Men and women, aged over 50: 1,200 mg per day*
   - Approximately, a 250 ml glass of milk contains about 300 mg of calcium.
   - Milk, yogurt, and cheese are the main food sources of calcium.
   - Fish, like sardines and salmon, are good animal sources of calcium.
   - Most grains (such as breads, pastas, cereals), are not rich in calcium, so additional supplements are needed.
2. **Vitamin D:** Vitamin D helps in absorption of calcium. The recommendation for vitamin D is 200–600 IU daily. Approximately a cup of milk contains 100 IU. Vitamin supplements can be taken if the diet does not contain enough of this nutrient following consultation with a physician. Too much vitamin D can be toxic. The body makes vitamin D in the skin when it is exposed to sunlight, roughly 10–15 minutes of sunlight to the hands, arms, and face, 2–3 times a week to get enough vitamin D. The amount of time depends on how sensitive your skin is to light, use of sunscreen, skin color, and pollution.

How can one prevent falls and fractures?

Preventing falls is of prime importance in treatment of osteoporosis. Domestic falls can easily cause fractures in fragile bones. Following are some tips to avoid falls.

Outdoors

- Use a walking aid like cane or walker.
- Wear rubber-soled shoes.
- Walk on grass when sidewalks are slippery.
- Be careful on highly polished floors especially if wet.

Indoors

- Keep rooms free of clutter, especially on floors.
- Keep floor surfaces smooth but not slippery.
- Wear supportive, low-heeled shoes even at home.
- Avoid walking in socks, stockings, or slippers.
- Be sure stairwells are well lit and that stairs have handrails on both sides.
- Install grab bars on bathroom walls near tub, shower, and toilet.
- Use a rubber bath mat in shower or tub.
- Keep a flashlight with fresh batteries beside your bed.
- If using a step stool for hard-to-reach areas, use a sturdy one with a handrail and wide steps.

What are the medications to treat osteoporosis?

Osteoporosis is best prevented, but once it sets in, aggressive medical management is the key. Different types of medications are now available. These include bisphosphonates, calcitonin nasal sprays, Calcium and Vitamin D supplements which prevent bone loss and are useful in early osteoporosis. Newer medicines like, tereparatide and denosumab help in building up the bone mass, reversing osteoporosis and are preferred line of treatment in advanced osteoporosis.

Is surgery required for osteoporotic spinal fractures?

Surgery is required rarely in spinal fractures unless it is accompanied by neurological deficit. Sometimes vertebroplasty/kyphoplasty (cement augmentation), which are day care procedures, are performed which provide excellent pain relief.

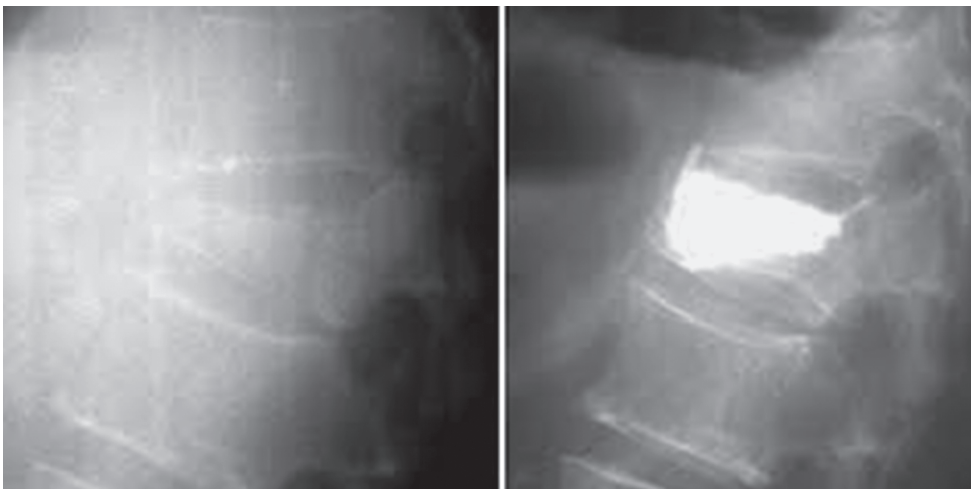


Fig. 1.2: X-ray of lumbar spine

REFERENCES

1. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. Osteoporos Int 2006:17:1726–1733. Available at: ADOI 10.1007/s00198-006-0172-4
2. Kanis JA, Melton LJ, Christiansen C, Johnstone CC, Khaltaev N. The diagnosis of osteoporosis. Journal of Bone and Mineral Research 1994 Aug;9(8):1137–1141.
3. Shatrugna V, Kulkarni B, Kumar PA, Rani KU, Balakrishna N. Bone status of Indian women from a low-income group and its relationship to the nutritional status. OsteoporosInt 2005 Dec;16(12):1827–1835.
4. Melton LJ, Chrischilles EA, Cooper C, Lane AW, Riggs BL. Perspective. How many women have osteoporosis? J Bone Miner Res 1992 Sep;7(9):1005–1010.

Biomechanics of Spine in Traditional Indian Movements

Rajani Mullerpatan
Professor and Director
MGM School of Physiotherapy
Kamothe, Navi Mumbai, India

Traditional Indian movement forms are a rich heritage of science, art and spirituality. Yoga held a distinct role in the lifestyle practices of ancient India. Yoga is believed to be a synchronous activity which blends the physical and mental. Yogasanas are known to provide a numerous benefits to the body in terms of improving joint mobility, maintaining muscle strength and improving metabolic status.

Suryanamaskar, referred as sun salutation, is one of the ancient forms of Yogasanas practiced. This yogasana is a sequence of 10 consecutive poses, producing a balance between flexion and extension, performed with synchronized breathing and aerobic activity.[1] Gentle transitions through sequences blended with breathing control have demonstrated improvement in metabolic profile, reduction in diastolic blood pressure, cardio-respiratory fitness, upper limb muscle endurance and body flexibility.[2–4] However, limited information is available on biomechanical exploration of this composite asana.

A few researchers have analyzed suryanamaskar using magnetometer and accelerometers and described kinematic component of transition from one posture to another. Further, Omkar et al (2011) evaluated effects of suryanamaskar on wrist, elbow, shoulder, hip, knee and ankle joints using mathematical model and reported dynamic moments with high magnitudes and rates, applied with unusual distribution patterns, optimal for osteogenesis and sub-maximal loading ensuring none of the joints were overstressed.[2] However, further exploration of joint angles of spine and lower extremity joints would enhance kinematic understanding of suryanamaskar to plan and prescribe interventional programs for people with musculoskeletal disorders. At MGM Center of Human Movement Science, we aimed to explore spine and lower extremity kinematics of suryanamaskar, using 3D motion analysis.

Following approval from Ethical Committee for Research on Human Participants, MGM Institute of Health Sciences, Navi Mumbai, 10 healthy trained yoga practitioners (five males, five females) were recruited. All participants provided informed consent as per the Declaration of Helsinki guidelines. The participants were screened for known musculoskeletal, cardiovascular, respiratory, metabolic, and neurologic disorders. Following screening and informed consent, the participants were instructed to perform the described 12 poses in sequence during motion capture.

Three-dimensional motion was captured with 12 camera Vicon system (Oxford Metrics Group, UK) at a sampling frequency of 100 Hz using 39 retro reflective markers (Fig. 1.3). Markers were secured with double-sided adhesive tape on predetermined anatomical landmarks defined by

the Plugingait model. The static trial was recorded while standing in anatomical position to enable calibration. Five dynamic trials of Suryanamaskar were captured, and data were processed using Plugingait model. Analog data were filtered at 10 Hz. Joint angles during 12 poses were computed within Vicon Nexus. Kinematics of the 12 poses is described further. The 12 pose sequences of Suryanamaskar include: Pose 1—Salutation Pose (Pranamasana), Pose 2—Raised Arm Pose (Hasta uttanasana), Pose 3—Hand to Foot Pose (Hastapaadasana), Pose 4—Equestrian Pose (Ashwasanchalanasana), Pose 5—Mountain Pose (Parvatasana), Pose 6—Eight Limb Pose (Ashtanganamaskara), Pose 7 – Cobra Pose (Bhujangasana), Pose 8—Mountain Pose (Parvatasana), Pose 9—Equestrian Pose (Ashwasanchalanasana), Pose 10—Hand to Foot Pose (Hastapaadasana), Pose 11—Raised Arm Pose (Hasta uttanasana), and Pose 12—Salutation Pose (Pranamasana).

During the entire cycle of suryanamskar, joints of spine (C7-L5) and lower extremity were observed to move through nearly full range of motion in sagittal plane. Movements were largely symmetrical in all poses except pose 4 and 9 which were reciprocal. Spine moved through 56° flexion to 47° extension alternating between flexion and extension exerting a stretch on posterior structures such as tendoachilles, hamstrings and dorsolumbar fascia during pose 3. Hip moved from 148° flexion to 15° extension applying a stretch on quadriceps bilaterally. Knee flexed up to 140° and ankle moved in a closed kinematic chain through 40° dorsiflexion effectively stretching the tendoachilles (Fig. 1.3).

Total time taken to perform the entire 12 pose sequence was approximately 44.83 (7.27) s. The total time required to attain a pose including hold time was 2.5–5.5 s. COM of the body was observed to rise and fall with the poses with the highest position attained during raised arm pose 94.7 (4.6) cm, whereas COM was the lowest during eight limb pose 15.1 (2.5) cm.

Suryanamaskar is a yogasana largely symmetrical in pattern following a graceful sequence of poses that move the spine and lower extremity joints through a near complete range of motion predominantly in the sagittal plane. One sequence of gentle exercise which mobilizes almost all body joints in <1 min holds huge potential for prescription as mobility exercise for people with time and space constraints typical to the hectic urban lifestyle globally. Moreover, the time taken for achieving each pose along with transition to the next pose was fairly well distributed ensuring

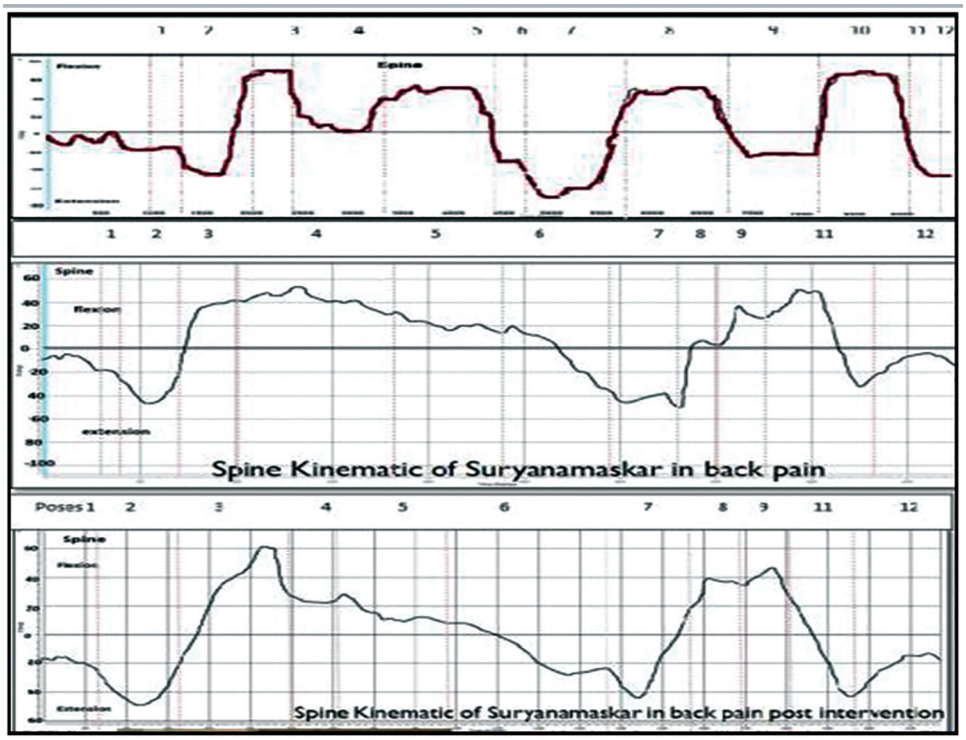


Fig. 1.3: Spine kinematics during Suryanamaskar in Yoga experts and people with back pain pre- and post-Suryanamaskar intervention

that loads were not sustained on one joint for prolonged duration of time. It holds huge potential as a single complete exercise to enhance flexibility and postural control of the body in a closed kinematic chain to impart benefits of weight bearing.

Further, growing prevalence of spine pain globally, demands strengthening of existing preventive measures by adding novel evidence based interventional practices. In view of excellent spinal mobility offered during the 12 poses of Suryanamaskar, alternating between flexion and extension and synchronized with breathing, its huge potential to improve spine joint motion, muscle strength and postural control was explored. A Suryanamaskar intervention was prescribed to people with chronic mechanical back pain. Post 6-weeks intervention, 15% improvement in maximum spinal flexion during pose 3 and 13% improvement in spinal extension during pose 7 ($p< 0.01$) were observed. Pain scores on Numeric Rating Scale improved by 50%, muscle strength of transverses abdominus and multifidus increased by 13% and functional disability score on the modified Oswestry Scale reduced by 54% reduction. It may be postulated that Yoga improves body movement along with active mindfulness; thereby promoting increased strength in the musculature and deeper relaxation, due to its bidirectional communication between the mental, nervous, and musculoskeletal systems.

In conclusion, integration of traditional movement forms like Yoga into current health care practices may provide sustainable benefits to patients in terms of pain relief, enhancement of muscle strength, increase in flexibility and reduction in functional disability.

REFERENCES

1. Jakhotia KA, Shimpi AP, Rairikar SA, Mhendale P, Hatekar R, Shyam A, Sancheti PK**.** Suryanamaskar: An equivalent approach towards management of physical fitness in obese females. Int J Yoga 2015 Jan; 8(1):27–36.
2. Omkar SN, Mour M, Das DA. Mathematical model of effects on specific joints during practice of the Sun Salutation a sequence of yoga postures. J Body Mov Ther 2011 Apr; 15(2):201–208.
3. Bhutkar MV, Bhutkar PM, Taware GB, Surdi AD. How effective is sun salutation in improving muscle strength, general body endurance and body composition? Asian J Sports Med 2011 Dec;2(4):259–266.
4. Tran MD, Holly RG, Lashbrook J, Amsterdam EA. Effects of hatha yoga practice on the health related aspects of physical fitness. PrevCardiol 2001Autumn; 4(4):165–170.
5. Salem GJ, Yu SS, Wang MY, Samarawickrame S, Hashish R, Azen SP, Greendale GA. Physical demand profiles of hatha yoga postures performed by older adults. Evid-based Complement Alternat Med 2013;2013:165763.doi: 10.1155/2013/165763.
6. Shankar G, Pancholi B. The Effect of Suryanamaskar Yoga Practice on the Heart Rate, Blood Pressure, Flexibility and Upper Body Muscle Endurance in Healthy Adult. Int J Health Sci Res 2011;1(1):33–39.

SYMPOSIUM II

Evaluation of Spine: Triage of Care

Primary Care Triage for Spine Disorders, 'Red Flags'

Keynote Address

Adam Wilkey DC, MSc
President World Spine Care Europe
Holmfirth, United Kingdom

The concept of medical triage has migrated from the battlefield into general medicine, including the spinal primary care setting, where it continues to uphold the concept of identifying those in most need of urgent care. The few presenting with Red Flags, indicating potentially serious spinal pathology, can be filtered quickly receiving the appropriate immediate or urgent referral. Beyond this small minority the principle of clinical triage is used to streamline and direct patients to a suitable evidence-based care pathway for their specific presenting symptoms. Many health care institutions and providers have developed individual musculoskeletal (MSK) triage systems for use within their locality and for the resources available to them. However, currently, there is no universally accepted triage system for general use within the care of MSK conditions. A recently published spinal classification has been proposed by the Global Spine Care Initiative. This classification has the potential to provide spinal triage that is adaptable across cultures and healthcare systems and can be readily employed at all levels of healthcare. The classification and triage are presented using a clinical model, with a revision of the concepts of MSK triage. The importance of identifying serious spinal pathology and psychosocial risk factors using red and yellow flags is reviewed with the aid of case studies.

INTRODUCTION

Historically the first evidence of structured medical triage was performed by the French during the Napoleonic Wars. The principle was to attend to the wounded, worst first, irrespective of rank. Later the British modified the concept by treating those most in need that was likely to survive allowing a greater focus of limited resources and manpower. This basic idea of triaging has continued to be employed in the battlefield and in disaster scenarios where limited resources play a role in the determination of who to treat as a priority and which cases are less of a priority. It has also migrated into mainstream medicine, is now common throughout the medical disciplines where decisions upon the priority of care play an essential role in care of the patient.

In the literature regarding musculoskeletal (MSK) triage three common themes have been identified:

- A triage aim
- A structure of the triage—who does it, when is it done and how
- The presence of a referral.

These themes form the basis of this presentation.

The aim, or why triage?

Spinal pain, particularly lower back (LBP) and neck pain, are among the most common conditions presenting to medical and allied practitioners for treatment. Due to the high combined incidence of these conditions, most people will suffer a degree of pain at some point during their life. Due to its ubiquity, difficulties in specific diagnosis and poor results of care 'packages' numerous treatment modalities have become available for those who suffer. Spinal triage is the method of identifying and prioritizing the needs of patients presenting with spinal conditions or concerns. The goal is to maximize the benefits of care and minimize unnecessary suffering and costs associated with unwarranted, unnecessary or unproven treatment that may lead to over-treatment or under-treatment of evidence-based care.

Of prime importance within the triage is the detection of potentially serious spinal pathology; vertebral fracture, axial spondyloarthropathy, malignancy (primary or secondary), infection and cauda equina syndrome. There are a number of clinical findings, or 'red flags', present within a case history and/or clinical examination that should alert the clinician to an increased risk of serious pathology. Red flags act as the clinicians 'Stop' sign, increasing awareness of potentially serious health hazards, and based upon the presenting clinical presentation assessing whether urgent or immediate referral is required. However, it is suggested that up to 80% of patients presenting with acute LBP will present with at least 1 red flag and 44 items of history or examination have been identified that could be considered red flags. Although there are geographical variations the actual percentage of patients presenting with serious spinal conditions is very low. Therefore, the presence of single red flags should be interpreted cautiously and within the context of the overall presenting condition, history, and examination.

The clinician should be thorough and not afraid to probe in-depth into the patient's condition and past history to gain adequate information to make an informed decision. The following have been identified as the most commonly reported significant red flags.

- Age over 50
- Bladder dysfunction
- History of cancer
- Immunosuppression
- Pain worsening at night
- History of trauma
- Saddle anesthesia
- Lower extremity neurological deficit
- Unexplained weight loss
- Recent infection
- Fever/chills

Triage is also important in the identification of Yellow flags, essential in the effective treatment of spinal conditions, especially those associated with chronic pain. Yellow flags are the psychological and social risk factors that could potentially act as barriers to recovery from pain and disability, including:

- A belief that (back) pain is harmful potentially severely disabling
- Fear avoidance behavior and reduced activity levels
- A tendency to low mood
- Withdrawal from social interaction
- High expectation of passive treatment rather than a belief that active participation will help
- Job dissatisfaction, work stress and belief that work will exacerbate the pain.

In summary an effective triage should enable the patient to receive the most effective treatment or care as quickly as feasible whilst minimizing potential harm and barriers to recovery.

Structure of Triage: Who, when and how of triage?

Providing there is adequate and correct information any person can be involved in the triage process. A patient self-presenting to any clinician has, in effect, performed a triage; they have decided that they are unable to manage their pain/condition without some form of assistance. They may have sought the aid of family, friends or 'Dr. Google'. They may present any number of clinicians from a wide variety of disciplines.

The responsibility of the spine care community is to educate and inform all stakeholders, including the public, incorrect triage. Traditional healers, general healthcare workers, or professionals such as GPs are often the first contact for patients suffering with or concerned about spinal problems. They should be aware of when to advise self-management and when to refer to spinal care specialists such as chiropractors, medical specialists, osteopaths, physiotherapists, and spinal surgeons.

The emphasis on evidence-based care has resulted in several guidelines being published for the treatment of back and neck pain. There are also, in fact, numerous MSK/spinal triage systems in operation throughout the world. However, the overall process is fragmented, there is no recognized standard for spinal triage and systems tend to be based upon resources available within organizations and communities. Whilst this may work within the specific organisation it can result in a 'language barrier' between organizations and slow the referral process and ultimately the timely and judicious care of the patient.

Therefore, the challenge is to develop a triage standard that is comprehensive, can be used by all stakeholders (including patients), is based upon a biopsychosocial model, and public health principles; they would be able to identify red flags and yellow flags; is easily linked to varying models of care, integrative and patient centered; adaptable culturally and to changes in the evidence base; and is user friendly.

In 2018, the Global Spine Care Initiative, a research arm of World Spine Care published a 'spinal classification system for spine-related concerns'. This paper describes the development of a triage process that can be used for spinal care in an easy to use, clearly defined manner. It is highly adaptable, in theory being able to be used at all levels of care from patients to surgeons, in low, middle and high-income communities and in clinical and research environments. It is responsive to all potential presentations of spinal problems, identifying red and yellow flags and considers pain, disability, psychological and social factors. It focusses on the needs of the patients and is user-friendly having charts and flashcards to assist both the practitioner and patient in the decision-making process.

There are 6 levels of spinal classification (Fig. 2.1) ranging from Class 0 where symptoms are minimal if present at all but caters here for patients with concerns regarding potential back problems, to class V the serious spinal pathologies.

Two levels of triage exist: An initial stage wherein patients and healthcare workers triage using class 0-V. Based upon the classification referral may be made to one of a number of spine care specialists. Prompts and guidance are provided by flashcards. Following referral, the spine care specialist can use the further sub-classifications within the six groups (Fig. 2.2) to assist in formulating a working diagnosis and from this determining the most appropriate care pathway.

Class 0 No or minimal symptoms	Class I Mild symptoms	Class II Moderate or severe symptoms	Class III Neurological symptoms	Class IV Spinal fracture or deformity	Class V Serious or systemic disease

Fig. 2.1: Six levels of spinal classification

Class 0: General population, no or minimal spine related symptoms[a], no interference with activities, no neurological deficits, no severe pathology

- Class 0a: No or minimal occasional discomfort, no evident risk factors for a spine related disorder or pain, potential for primary prevention[b]
- Class 0b: No or minimal occasional discomfort, one or more risk factors for a spine related disorder or pain, potential for primary prevention[b]

Class I: Spine related symptoms[a], no or minimal interference with activities, no neurological deficits, no severe pathology

- Class Ia: Acute or subacute[c] mild pain with no or minimal interference with activities of daily living[d]
- Class Ib: Chronic or recurrent[e] mild pain with no or minimal interference with activities of daily living[d]

Class II: Spine related symptoms[a], interference with activities, no neurological deficits, no severe pathology

- Class IIa: Acute or subacute[c] moderate pain with interference with activities of daily living[f]
- Class IIb: Chronic or recurrent [e] moderate pain with interference with activities of daily living[f]
- Class IIc: Acute or subacute[c] severe pain with interference with activities of daily living[g]
- Class IId: Chronic or recurrent[e] severe pain with interference with activities of daily living[g]

Class III: Spine related symptoms[a] with neurological symptoms or deficits, interference with activities, focal pathology compromising neural structures

- Class IIIa (acute/mild): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Likely to require immediate intervention.
- Class IIIb (acute/progressive): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Likely to require immediate (possibly emergency) intervention.
- Class IIIc (chronic[e]/stable [h]): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Unlikely to require immediate (emergency) intervention.

Class IV: Spine related symptoms with severe deformity[a], with or without interference with activities, with or without neurological deficits

- Class IVa: Stable,[h]chronic[e] spine pathology without correlation with symptoms (e.g. low grade or stable spondylolisthesis, spinal deformities, scoliosis, spinal stenosis, stable healed fractures and congenital disorders)
- Class IVb: Stable,[h] acute or chronic[e] spine pathology with correlation to symptoms (e.g. symptomatic high grade and unstable spondylolisthesis, spinal deformities, scoliosis, spinal stenosis, fractures and congenital disorders)

Class V: Spine related symptoms[a] with severe or systemic pathology, interference with activities, with or without neurological deficits

- Class Va: Severe acute spinal pathology likely to require immediate (emergency) intervention. (e.g. unstable fractures, acute infections)
- Class Vb: Severe, slowly progressive spinal pathology. Requires intervention but not an emergency (e.g. inflammatory joint diseases, osteoporosis with stable compression fractures, destructive pathology such as neoplasms or chronic infections)
- Class Vc: Spine symptoms originating from non-spine pathology that require intervention (e.g. referred angina, genitourinary tract infections, cerebrovascular dissections)

Legend for the GSCI Spinal Disorders Classification

a. Symptoms = spine related symptoms: (e.g. pain, psychological symptoms, psychosocial stress, altered sensation, weakness, incoordination, incontinence, breathing difficulties, etc.)
b. Prevention = public and population health intervention measures to reduce or prevent injury and spinal disorders. These may include occupational injury prevention, social policy (e.g. no-fault insurance), prenatal care (e.g. nutrition to prevent spina bifida), osteoporosis screening, exercise programs, etc.
c. Acute or subacute = as defined by the evidence for a specific intervention, usually ≤3 months
d. Mild pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores[16] "mild" (score 8–27) pain (i.e. 8 = least impact to 50 = greatest impact)
e. Chronic or recurrent = as defined by the evidence for a specific intervention, usually > 3 months
f. Moderate pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores [16] "moderate" (score 28–34) pain (i.e. 8 =least impact to 50 = greatest impact)
g. Severe pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores[16] "severe" (score ≥35) pain (i.e. 8 = least impact to 50 = greatest impact)
h. Stable = unchanging and unlikely to change in the short term but may require symptomatic care
i. Progressive = increasing symptoms, pathology or deficits

Fig. 2.2: Subclassifications of the 6-level spinal classification (abstracted from bibliography 10)

The Referral

Triage is based upon gleaning adequate information from the patient. In a clinical scenario, this necessitates a history is taken and an examination. During the first, or 'screening' triage basic historical information is required; where is it located and how and when did the pain start. Is the condition interfering with normal daily activities; is there obvious neurological involvement, pins, and needles, numbness, loss of balance or gait disturbance. Is there a recent history of trauma falls or traffic accidents; is their obvious deformity visible, scoliosis, increased thoracic kyphosis; and does the history suggest signs of serious or systemic pathology.

Generally, Class 0 and Class1 can often be self-managed. Classes II–V will require referral to some form of a clinician specializing in spinal conditions. Flashcards and charts guide the referral pathway and its level of urgency. Following referral, the spine care specialist will perform more in-depth interviews and examination providing a diagnosis and with the aid of the triaging classification protocols establish an appropriate care pathway (Fig. 2.2).

BIBLIOGRAPHY

1. Iverson K, Moskop JC. Triage in Medicine, Part I: Concept, History, and Types. Ann Emerg Med 2007 Mar; 49(3): 275–281.
2. Morris JH, James RE et al. What is Orthopaedic Triage: A Systemic Review. J Eval Clin Pract 2015 Feb; 21(1): 128–136.
3. Bardin LD, King P, Maher CG. Diagnostic triage for low back pain: a practical approach for primary care. Med J Aust. 2017 Apr; 206(6): 268–273.
4. Foster NE, Anema JR et al. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018 Jun; 391(10137): 2368–2383.
5. Hartvigsen J, Hancock MJ et al. What low back pain is and why we need to pay attention. Lancet 2018 Jun; 391(10137): 2356–2367.
6. Cedraschi C, Nordin M, et al. The Global Spine Care Initia- tive: a narrative review of psychological and social issues in back pain in low and middle-income communities. Eur Spine J 2018 Sep; 27(Suppl 6): 828–837.
7. Chou R, Côté P et al. The Global Spine Care Initiative: applying evidence-based guidelines on the non-invasive management of back and neck pain to low- and middle-income communities. Eur Spine J 2018 Sep; 27(Suppl 6): 851–860.
8. Nordin M, Randhawa K, et al. The Global Spine Care Initiative: a systematic review for the assessment of spine-related complaints in populations with limited resources and in low- and middle-income communities. Eur Spine J 2018 Sep; 27(Suppl 6): 816–827.
9. Haldeman S, Johnson CD et al. The Global Spine Care Initiative: classification system for spine-related concerns. Our Spine J 2018 Sep; 27(Suppl 6): 889–900.
10. Haldeman S, Johnson CD et al. The Global Spine Care Initiative: care pathway for people with spine-related concerns. Eur Spine J 2018 Sep; 27(Suppl 6): 901–914.

Physical Examination of Spine

Dr Pradnya Girdhar
Assistant Professor
MGM School of Physiotherapy
Kamothe, Navi Mumbai

The physical examination is one of the most important skills needed for accurate decision making in any clinical field. With the advent of more advanced imaging technology, we are relying less on the history and physical examination for clinical decision making. Physical examination is just as important, if not more so, in this day and age of advanced imaging. Ultimately, clinicians need to treat the patient and not image findings, which in many cases are incidental.[1]

Physical examination refutes or supports the pain pattern identified in history. Physical examination and the ability to differentially diagnose accurately are critical components of physiotherapy. However, the decisions that clinicians/therapists use to select their preferred evaluative tools are often based on tradition or what was learnt during initial professional training rather than on science. Although some questions and examination procedures may be very helpful in establishing an accurate diagnosis, others may be utterly useless and serve only to distract both patients and clinicians.

With the rapidly expanding amount of recent research investigating the diagnostic utility of tests and measure, it is essential for clinicians and therapists to use selective components of the history and physical examination that are supported by current best evidence.[2]

Over the past several years, evidence-based practice has become the standard in the medical and health care professionals. As described by Sackett and colleagues *(Evidence-Based Medicine: How to Practice and Teach EBM)*, evidence-based practice is a combination of three elements: The best available evidence, clinical experience and patient values. Integration of these three elements help form a diagnostic and therapeutic alliance between patients and clinicians. The contribution of these elements in identifying a diagnosis or planning an effective management is very significant.

Physical examination of spine is considered difficult because of the varied structures that contribute to the signs and symptoms in a patient. In spite of numerous tests proposed in the literature, it is still controversial to point at the exact structure that is producing pain.

Both direct and indirect musculoskeletal impairments can contribute to functional limitations and disability that can affect a patient's ability to perform certain tasks and roles in the society. The physical examination of spine is performed to:[3]

1. Determine the presence or absence of impairments, functional limitations and disability involving muscles, joints and other related structures.
2. Identify the specific tissues that are causing/contributing to the impairment, functional limitation or disability.

3. Determine the baseline status.
4. Help formulate appropriate anticipated therapeutic goals, expected outcomes and plan of care.
5. Evaluate the effectiveness of rehabilitation, medical or surgical management.
6. Identify the risk factors to prevent development or worsening of impairments, functional limitations or disabilities.
7. Motivate the patient.

We have discussed the steps followed in the physical examination of spine. Special emphasis is laid on the identification and screening of red flags.The acronym **NIFTI** can help the remember red flags:

1. **N**eurological: Diffuse motor/sensory loss, progressive neurological deficits, cauda equina syndrome.
2. **I**nfection: Fever, IV drug use, immune suppressed.
3. **F**racture: Trauma, osteoporosis risk/fragility fracture.
4. **T**umour: History of cancer, unexplained weight loss, significant unexpected night pain, severe fatigue.
5. **I**nflammation: Chronic low back pain >3 months, age of onset <45, morning stiffness >30 minutes, improves with exercise, disproportionate night pain

Posture as an outcome measure in assessment of spine has been in controversy recently. The main reasons for carrying out postural assessment are to acquire information, save time, establish a baseline and to treat holistically.[4] Currently, whatever the population under consideration (healthy or subjects with pathologies), the objective of the postural task and the environmental conditions, postural control can be appropriately evaluated in terms of postural performance and strategy by using reliable technological tools and tests. However, available postural analyses tools are yet to be experimentally verified for optimum clinical application. Refinement in the analysis of the contribution of sensory, central, and motor components to postural behavior is subject to future technological progress as well as advances in knowledge about postural function.[5]

Like posture, assessment of range of motion and muscle strength has been considered to reflect poor outcomes for the patients. Both components are subject to change under the influence of pain. Whether muscle weakness is a result of pain or pain is due to weakness is still unclear in literature. Similarly present research is inconclusive as to the relevance of the findings from Spinal Motion Palpation, with respect to the patient's pain complaints. Differences in the testing methods and interpretation of spinal mobility testing are problematic. It is extremely important for the clinical therapist to correlate the findings of spinal motion palpation to the patients' functional problems.

The choice of special tests used during the examination should be relevant to the presenting complain of the patients. Various special tests have been in use in spine but the use of specific tests help reach the diagnosis accurately. Use of cluster tests for radiculopathy, SI and disc injuries have been discussed with their specificity, sensitivity and positive likelihood ratios.

The recent trend of relying on investigations to diagnose a particular case is discussed. Current literature suggests that individuals without pain also have changes in their MRIs and hence these investigations should be used as important diagnostic adjuncts and should not be relied upon entirely to treat a patient.

Lastly the importance of performing neurological screening of every patient through assessment of dermatomes, myotomes and reflex testing is emphasized.

Examination can be considered as a part of jigsaw puzzle, it is an ever evolving process which changes with change in the symptomatology of patients. It is always better to consider physical examination as work in progress, rather than an end point.

CONCLUSION

Physical therapists today practice in complex environments and are called upon to reach increasingly complex decisions under significant practice constraints. Hence thorough examination and its interpretation based on sound clinical reasoning is the pillar of a strong rehabilitation protocol. Examination begins with patient referral or initial entry and continues as an ongoing process throughout the course of rehabilitation.

REFERENCES

1. Albert TJ, Vaccaro AR. Physical Examination of the Spine, 2nd edition. New York: Thieme. 2005. 130p.
2. Cleland J, Koppenhaver S. Netter's Orthopaedic Clinical Examination: An Evidence-Based Approach (Netter Clinical Science), 2nd Edition, Philadelphia: Saunders, 2005. 576p.
3. O'Sullivan SB, Schmitz TJ, Fulk GD. Physical rehabilitation. 6th edition. Philadelphia: F.A. Davis, 2014.pp.108–109.
4. Paillard T, Noe F. Techniques and Methods for Testing the Postural Function in Healthy and Pathological Subjects. Biomed Res Int. 2015;2015:891390. doi: 10.1155/2015/891390.
5. Nyberg RE, Russell Smith A Jr. The Science of Spinal Motion Palpation: a review and update with implications for assessment and intervention. J Man ManipTher 2013 Aug;21(3):160–167.

Radiological Evaluation of Spine

Alberto Zerbi MD
Professor and Head
Department of Diagnostic and Interventional Radiology
Istituto OrtopedicoGaleazzi
Milan, Italy

The radiological evaluation of the spine pathologies is based on several imaging techniques to be merged in a clinical-based protocol to obtain the best diagnostic outcome at the lowest economical and biological cost. Plain X-ray, CT, MRI must be done following a shared protocol that takes in count the technical possibilities of the imaging technology at hand together with the clinical request.

The first imaging step is plain X-ray, the cheapest and the most widespread in the area.

Plain X-ray of the whole spine or segmental spine studies request maximum commitment by the technician to give to the radiologist and the clinician the information needed to confirm or exclude the suspected pathology. Plain X-ray has low economical cost but shows a biological cost due to radiation exposure to the population that must be well known to avoid unnecessary radiation dose to the population. X-rays are obtained by using a small dose of radiation to penetrate bone and soft tissues of different densities to directly visualize the bony parts of the spinal column. X-rays are non-invasive and can help detect aging changes in the spine and the discs, spinal alignment and curvature, spinal instability, congenital defects of the spinal column, and fractures caused by trauma, osteoporosis, infections, or tumours.

Plain X-ray allows to perform dynamic studies of the spine taken at different positions, bending forward and backward and laterally, to assess for instability. Whole spine imaging is a radiological examination that exposes the whole spine to X-ray radiation. It is usually repeated during the treatment period, which results in a much greater radiation exposure than that in routine X-ray examinations. Scoliosis patients routinely undergo sequential studies, and it is estimated that the typical patient with scoliosis will have approximately 22 radiological examinations over a 3-year treatment period. In a study[1] of the incidence of cancer in a cohort of adolescent idiopathic scoliosis patients treated 25 years previously, investigators have found that patients treated with bracing or surgery had an overall cancer rate of 4.3%. This is five times higher than that of an age-matched Danish population and is probably due to the radiation exposition.

CT imaging is a powerful tool in the hand of radiologist. The actual technology allows the patient to be studied fast and with very low radiation dose. Nevertheless the dose given to the patient is in the order of 10 to 100 times that of a standard X-ray so that the CT examination should be aimed strictly to the zone of interest, that means 2–3 vertebrae, avoiding to study the whole lumbar or cervical spine.

CT scan is a machine that uses a radiation source to obtain multiple 2-dimensional and reconstructed 3-dimensional images of body segments including the spine. Multiple cross-sectional

images are obtained of the affected areas of the spine. These images provide very detailed information regarding the bony anatomy of the spine.

They are especially useful in visualizing degenerative or aging changes in the spine, spinal alignment, fractures and fracture patterns, congenital/ childhood anomalies of the spine, herniated discs, and areas of narrowing in the spinal canal and foramina and to evaluate the effects of treatment of the spine, such as surgery or other therapy.

With the modern generation of CT scanners, entire segments of the spine can be imaged within a matter of minutes. A contrast dye may sometimes be injected in order to better visualize soft tissue structures and blood vessels. MRI is a free radiation dose extremely powerful diagnostic technique. MRI has become the gold standard in establishing a diagnosis for many patients with spinal disorders. MRI uses a magnetic field to align the nuclei of hydrogen atoms in water in the body and then provides radio frequency pulses to alter this alignment. The change in the magnetic field and energy given off by these atoms is detectable by the scanner and computerized to provide detailed images of the body.

MRI allows very precise diagnosis about disc, cord, roots and ligaments pathologies as well as vertebral bone, with panoramic and multiplanar views of the spine. Degenerative disc and joints diseases, areas of narrowing and compression of the spinal cord and spinal nerve roots.

The disc health is well demonstrated by MRI that can show not only the shape and width of the disc but its hydration too with SET2W or STIR imaging. This may be easily classified by Pfirrmann scale.

Changes in the bone marrow signal intensity close to the endplate comparing the SET1 signal intensity and the SET2 and STIR signal intensity, correlate to acute or chronic degenerative or inflammatory pathologies, and may be classified by Modic scale. Chronic osteoarthritic processes of the facet joints involve active synovial inflammation, which can be detected using MRI with a fat-saturation technique. Facet synovitis appears to correlate with the patient's pain as well as the disc shape and signal intensity and the Modic changes of the endplates are related to the degenerative and inflammatory pathologies of the spine.

Low back pain refers to spinal and paraspinal symptoms in the lumbosacral region. The differential diagnosis of low back pain is broad and includes mechanical and nonmechanical causes.[2]

For most patients with acute low back pain in primary care, the ethiology is thought to be a mechanical cause involving the spine and surrounding structures. Unfortunately, in most cases, a precise pathoanatomic cause cannot be reliably confirmed by physical examination or diagnostic testing. This is due to weak associations among symptoms, examination findings, and anatomic changes. In contrast to the nonspecific ethiology of most mechanical causes, non-mechanical causes (such as cancer or infection) can be diagnosed with greater certainty. However, they represent a small fraction of acute low back pain in primary care. Thus, for patients with acute low back pain, an exact ethiology is identifiable in only about 15%.[3]

Tumoural, infective and traumatic pathologies are effectively identified by MR imaging.

The differential diagnosis among tumoural, infective and traumatic pathologies may be effectively achieved by an MRI study since they differ in pattern and signal characteristic.

Specific sequences and techniques may be used to further differentiate those pathologies (e.g. Diffusion Weighted Imaging is effective in differentiate pathological from non-pathological traumatic or insufficiency fracture of the vertebral bodies).

MRI is excellent for visualizing abnormalities of the spinal cord. Intravenous contrast is sometimes administered to better visualize structures or abnormalities in the spine.

MRI may be effectively used when metallic implants are in place. Techniques to reduce the metallic artefacts due to magnetic field interference (such as MARS technique: Metallic Artefact Reduction Sequences are used when a postoperative MRI is needed in an instrumented spine both in the immediate postoperative or the follow-up.

While MRI is a powerful diagnostic technique it is a very complex one. There are several different sequences modalities, from the basic Spin Echo to the Gradient Echo, to the Water or Fat saturation techniques (FATSAT, STIR, SPAIR), to Diffusion (DWI) and Tractography (DTI), just to mention the most popular. For this reason the imaging protocol must be specific for each pathological condition in order to achieve the result. Moreover, the imaging protocol depends on the technical characteristic of the MR Unit (age, Tesla Unit Power, coils, etc.)

Ultrasonography and Spine

Osseo-ligamentous lumbar spine is inherently unstable and is dependent on the integrated function of the muscles (especially paraspinal muscles) and neural subsystems for stability and movement. Among the paraspinal muscles lumbar multifidus (LM) has a unique role in spinal stabilization and contributes to almost 2/3 of lumbar spine stability especially in the lower lumbar section and is the predominantly affected paraspinal muscle in patients with LBP. In healthy subjects, the LM muscles are round or oval in shape, symmetrical between sides and increase in size cephalo-caudally. The most commonly used imaging studies for evaluation of paraspinal muscles are CT, MRI and ultrasound imaging. Important aspects of muscles assessed using US are muscle size, density and muscle contraction. LM atrophy is a common finding (around 80%) in patients with chronic LBP.

Using US, it has also been shown that the pattern of the multifidus CSA change in various postures differs in healthy subjects from patients with LBP; in healthy subjects multifidus CSA increases from prone lying to upright standing, then gradually decreases during forward flexion while in patients with chronic LBP forward flexion produces a further increase in CSA.

Patients with chronic LBP may also show changes in the density and appearance of damaged paraspinal muscles. Infiltration of fat into the muscle and replacement of muscle fibres with fat cells results in decreased muscle density.

Measurement of changes in muscle activation associated with LBP[4] can lead to development of selective interventions to reverse the identified impairment. This goal may be achieved with US. It was demonstrated that the ability of patients with chronic LBP to activate the LM at the affected lumbar section is reduced, as evidenced by smaller increases in thickness on RUSI images during contraction compared to contralateral normal side muscle or asymptomatic control subjects.

REFERENCES

1. Simony A, Hansen EJ, Christensen SB, Carreon LY, Andersen MO. Incidence of cancer in adolescent idiopathic scoliosis patients treated 25 years previously. Eur. Spine J. 2016 Oct; 25(10):3366–3370.
2. Atlas SJ, Deyo RA. Evaluating and Managing Acute Low Back Pain in the Primary Care Setting. J Gen Intern Med. 2001 Feb; 16(2): 120–131.
3. White AA, Gordon SL. Synopsis: Workshop on idiopathic low-back pain. Spine.1982 Mar-Apr; 7(2):141–149.
4. Heidari P, Farahbakhsh F, Rostami M, Noormohammadpour P, Kordi R. The Role of Ultrasound in Diagnosis of the Causes of Low Back Pain: a Review of the Literature. Asian J Sports Med 2015 Mar; 6(1): e23803. doi: 10.5812/asjsm.23803. Epub 2015 Jan 19.

SYMPOSIUM III

Spine Disability: Various Patient Groups and Different Perceptions

Spinal Cord Injury Rehabilitation

Keynote Address

Kuldeep Raj Salgotra
Professor and Director
Department of Orthopedics
Medical Superintendent
MGM Hospital
Kamothe, Navi Mumbai, India

Spinal cord injury (SCI) produces either temporary or permanent changes in motor, sensory or autonomic functions resulting from injury to spinal cord. SCI usually leads to permanent and often wreaking neuro deficits and disabilities. Management of SCI patients thus primarily involves prevention of complications related to the disability. Effective and timely physiotherapy and nursing care help in reducing complications due to mobility.

The goals following a SCI are to establish the level of injury of the spinal cord and initiate treatment to prevent further damage to the cord either due to mechanical instability or cardiovascular/respiratory complications secondary to injury. Staff trained in transferring such patients forms a very important link to reduce such life-threatening complications.

Signs and Symptoms

Spinal cord injuries are classified based on the gradings of American Spinal Injury Association Scale (ASIA).[1] The most common neurologic level of injury is C5, T12 and L1 are the most common level leading to paraplegia.[2]

Mechanisms

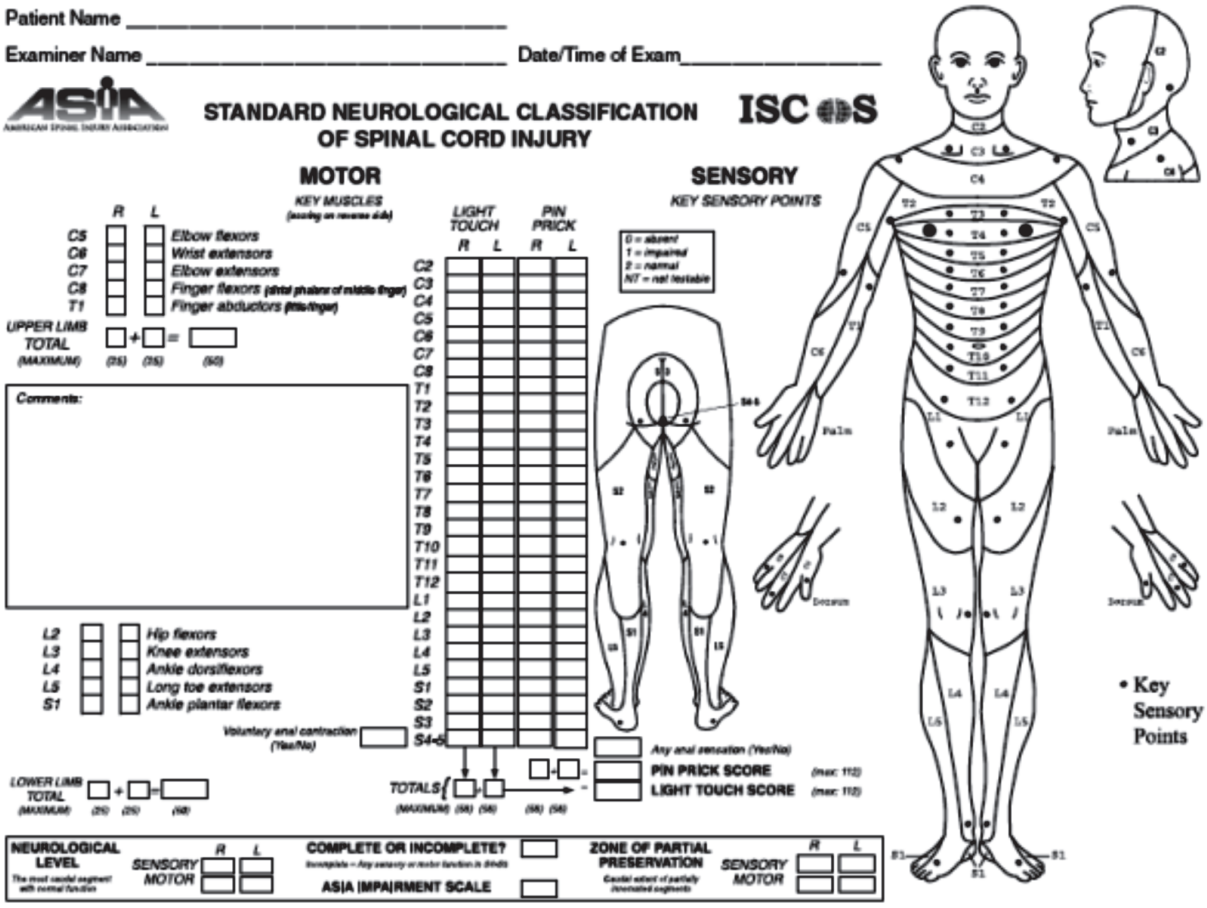
Injury to spinal cord can result due to:

1. Direct trauma to the cord either due to road traffic accident, fall, etc.
2. Compression of the cord by disc, space occupying lesion, bone fragments.
3. Impingement of spinal arteries producing cord ischemia[3]

All the above mentioned mechanisms can produce subsequent cord oedema.

Guidelines Summary

Guidelines pertaining to management of spinal cord injuries focus on prevention of secondary injury from compressive lesions and hemodynamic instability. The 2013 update of the AANS/CNS *Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injury* include the following recommendations.[4,5]



Immobilization

Immobilization is recommended for patients, who at the time of trauma, are not able to move upper/lower limbs and have suffered severe damage to the spine. Patients who are able to move their upper/lower limbs and are conscious do not need immobilization of the spine. Rigid cervical collar along with supportive blocks on a backboard limits cervical spine motion effectively and is highly recommended.

The long-standing practice of attempted spinal immobilization with sandbags and tape is insufficient and is not recommended.

Radiographic Assessment

Radiological assessment should be performed judiciously in SCI patients. A conscious patient without neck pain or distress, with normal neurological examination and functional range of movement for cervical spine should not be subjected to radiological assessment.

For a conscious, symptomatic patient, high-quality computed tomography (CT) imaging of the cervical spine is recommended.

In the obtunded or unevaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice.

Pharmacological Therapy

Earlier Methylprednisolone (MP) was recommended for the treatment of acute spinal cord injury (SCI), but now it is no more recommended as it is not approved by the Food and Drug Administration (FDA) for this condition.

Rehabilitation

Patients with SCI require extended treatment in specialized spinal units.[6] Early rehabilitation typically commences in an intensive care unit, continues in an inpatient unit and lasts for 8–12 weeks. Outpatient rehabilitation phase lasts for 3–12 months followed by yearly medical and functional evaluation.[7] A comprehensive multi-disciplinary rehabilitation team inclusive of *physical therapist*, *occupational therapist*, *recreational therapist*, nurse, social worker, psychologist and other health care professionals decide treatment goals appropriate for the person's condition.[8]

Functional recovery and independence in performing activities of daily living, recreational activities, and employment is influenced by level and severity of injury.[9] Outcome measures such as *Functional Independence Measure* (FIM) are used to assess function throughout the rehabilitation process following a spinal cord injury.[10] People with SCI need assistive devices such as ankle foot orthosis (AFO), knee –AFO, crutches and canes to function independently. However, energy cost of walking still remains high leading to early fatigue.[11] Engagement in physical activity increases chances of recovery.[12]

Prognosis

Spinal cord injuries generally result in at least some residual impairment despite the best possible treatment. Level and completeness of injury, as measured by the ASIA impairment scale, is a good predictor of prognosis.[13] Neurological score immediately 72 hours following injury is the best predictor of functional outcome.[14]

CONCLUSION

Functional outcome following SCI is dependent on factors such as level and extent of injury, neurologic recovery, associated medical complications (pain, spasticity, contractures, cardiac disease, musculoskeletal injury), rehabilitation, level of expertise, patient motivation, age, family support and financial resources.

REFERENCES

1. American Spinal Injury Association. *International Medical Society of Paraplegia. International Standards for Neurological and Functional Classifications of Spinal Cord Injury Patients*. Chicago, IL: American Spinal Injury Association; 2000: 1–23.
2. Ditunno JF Jr, Young W, Donovan WH, Creasey G. The international standards booklet for neurological and functional classification of spinal cord injury. American Spinal Injury Association. *Paraplegia*. 1994 Feb. 32(2): 70–80.
3. Waters RL, Adkins RH, Yakura JS. Definition of complete spinal cord injury. *Paraplegia*. 1991 Nov; 29(9):573–81.
4. Walters BC, Hadley MN, Hurlbert RJ, Aarabi B, Dhall SS, Gelb DE, Harrigan MR, Rozelle CJ, Ryken TC, Theodore N. Guidelines for the management of acute cervical spine and spinal cord injuries: 2013 update. *Neurosurgery*. 2013 Aug; 60(CN Suppl 1):82–91.
5. American Association of Neurological Surgeons and the Congr. Guidelines for the Management of Acute Cervical Spine and Spinal Cord Injuries. Congress of Neurological Surgeons. Neurosurgery 2013 Mar; Available at: *https://www.cns.org/guidelines/guidelines-management-acute-cervical-spine-and-spinal-cord-injuries*
6. Management of acute spinal cord injuries in an intensive care unit or other monitored setting. Neurosurgery 2002 Mar; 50(3 Suppl): S51–S57.
7. Cifu DK, Lew HL. Handbook of Polytrauma Care and Rehabilitation. Demos Medical Publishing. 2013; 290p. ISBN 978-1-61705-100-5.
8. National Institute of Neurological Disorders and Stroke. Spinal Cord Injury: Hope through Research. National Institutes of Health. Available at: *https://www.ninds.nih.gov/disorders/patient-caregiver-education/hope-through-research/spinal-cord-injury-hope-through-research*
9. Weiss JM. "*Spinal cord injury*". In WeissLD, Weiss JM, Pobre T. Oxford American Handbook of Physical Medicine and Rehabilitation.Oxford: Oxford University Press, 2010. ISBN 978-0-19-970999-1.
10. Chumney D, Nollinger K, Shesko K, Skop K, Spencer M, Newton RA. Ability of Functional Independence Measure to accurately predict functional outcome of stroke-specific population: systematic review. J Rehabil Res Dev 2010; 47(1):17–29.

11. Del-Ama AJ, Koutsou AD, Moreno JC, de-los-Reyes A, Gil-Agudo A, Pons JL. Review of hybrid exoskeletons to restore gait following spinal cord injury. J RehabilRes Dev2012; 49 (4): 497–514.
12. Frood RT. The use of treadmill training to recover locomotor ability in patients with spinal cord injury. Biosci Horizons: IntJ Student Res 2011 Mar; 4(1):108–117.
13. Peitzman AB, Schwab W, Yealy DM, Rhodes M, Fabian TC. The trauma Manual: Trauma and acute care surgery. *Philadelphia: Lippincott Manual Series* 2012. p.293.
14. *Scivoletto G, Tamburella F, Laurenza L, Torre M, Molinari M.Who is going to walk? A review of the factors influencing walking recovery after spinal cord injury. FrontHum Neurosci 2014 Mar; 8: 141*.doi: 10.3389/fnhum.2014.00141. eCollection 2014.

Disability Related to Spine Disorders: WHO Concept of Disability

Carol Cancelliere
Faculty of Health Sciences
University of Ontario Institute of Technology
Toronto, ON, Canada

Approximately 15% of the world's population experiences disability, that is, significant difficulties in functioning. This proportion will continue to increase as the population ages, and the number of people living with chronic health conditions rises. Persons with disability include those who have long-term physical, mental, intellectual or sensory impairments who face various environmental or personal barriers. This, in turn, inhibits their full and effective participation in society. At some point in life, everybody is likely to experience disability or have a family member or friend experience difficulties in functioning. Disability is a public health issue worldwide because people with disability confront a wide range of barriers in accessing health and community services, such as rehabilitation, and have worse health outcomes than people without disability.

Spinal disorders, such as back, neck pain or lumbar spine stenosis are leading causes of disability globally. The recently published Lancet Low Back Pain series emphasized that the costs associated with health care and work disability attributed to low back pain are enormous. The authors highlighted the urgent need to address the management of disability related to low back pain. This brief paper defines the World Health Organization's (WHO) concepts of disability, functioning and rehabilitation using a case example, and calls for a 'whole-systems' approach to preventing or reducing disability.

Disability and Functioning: A Biopsychosocial vs. Biomedical Model

The biomedical model of health has historically dominated much of healthcare. This model dictates that disability is strictly the consequence of disease. However, the World Health Organization uses a biopsychosocial model—the *International Classification of Functioning, Disability and Health* (ICF) model to define disability, which is neither simply biological nor a social phenomenon. Rather, disability is an "umbrella term for impairments, activity limitations and participation restrictions, denoting the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual (environmental and personal) factors". The ICF framework provides a useful and meaningful way to understand, measure, and describe disability in patients. It consists of six domains:

1. Health condition (e.g. low back pain, diabetes);
2. Body functions and structure (e.g. pain, joint degeneration);
3. Activity: Ability to execute a task such as lifting;
4. Participation: Involvement in a life situation (e.g. taking care of children, work);

5. Environmental factors: Physical, social and attitudinal environment in which people live and conduct their lives; and
6. Personal factors (e.g. age, gender).

When we are functioning, ultimately that means that we are participating in life despite our specific health conditions and activity limitations. Functioning is at the other end of the continuum compared to disability, denoting the positive aspects of the interaction between a person's health condition and their contextual factors (personal and environmental facilitators such as a good expectation of recovery, supervisory support, and work accommodations).

CASE EXAMPLES

Case 1: 63-year-old Truck Driver

Jim was involved in a car accident and got whiplash three months ago. He still experiences neck pain and stiffness, and, therefore, is unable to drive all day the way he used to before his injury. He is concerned because he needs to get back to work to support his family. Jim is disabled because he is unable to return to his regular job duties; however, the whiplash injury alone did not result in his disability. There may be other barriers contributing to the disability in both his physical and social environment. In his physical environment, his employer may not have offered him work modifications or accommodations to allow him to continue to work. For example, the employer could consider accommodations such as limiting his work hours or driving distance. The employer may also assign alternative duties such as equipment maintenance, administrative work or other suitable duties to allow Jim to continue to work while recovering. In his social environment, perhaps Jim's healthcare provider is discouraging him from returning to driving because s/he is fearful that going back to work might exacerbate his symptoms. Perhaps Jim's family members are concerned that returning to work might harm him; and perhaps Jim's supervisor and peers are not being supportive during his recovery. Based on evidence-based recommendations, educating all involved about the importance of graded activity and return-to-work, and removing physical and social barriers in Jim's work and home environment will be important to facilitate Jim's participation at work.

Case 2: 42-year-old Daycare Worker

Lisa applied for sick leave 10 weeks ago due to low back problems. Her pain coincided with starting a new job providing daycare to toddlers. Aggravating activities included sitting on the floor, lifting children, and vacuuming. She did not get relief from taking anti-inflammatory medication and her medical physician referred her to a physiotherapist. During a comprehensive assessment, the physiotherapist discerned that not only was Lisa experiencing pain and reduced mobility; but also exhaustion, worries and anxiety. The physiotherapist worked with the employer on a return-to-work plan for Lisa. While Lisa was undergoing clinical care, her employer offered her modified work duties where she did not have to lift children or sit on the floor. The physiotherapist supported Lisa in mastering the physical demands relevant to her job. She participated in a 'Nordic Walking' group to improve her endurance, practical task training (e.g. simulated lifting of toddlers up from the ground), education for proper body ergonomics, and pain management strategies. Additionally, cognitive behavioural therapy and reassurance reduced her fear of movement and anxiety level. After six weeks, Lisa was able to return to work and perform her full duties. Lisa's physiotherapist and employer agreed to monitor Lisa's work reintegration and developed recommendations to help Lisa maintain her functioning level and stay at work. Coordination and communication between Lisa's healthcare providers and employer, in addition to addressing environmental and personal barriers, were key to getting Lisa back to work.

Applying the International Classification of Functioning, Disability and Health (ICF) Model

The ICF provides a framework to describe human functioning on a continuum. The ICF offers an international, scientific tool to study all of the dimensions of disability. It may be used by people

from a broad range of backgrounds and disciplines, and across different sectors and care settings (e.g. rehabilitation centres, primary care, hospitals, community services and support). To plan rehabilitation programs, for specific conditions such as low back pain, instead of using the entire ICF (1400 categories), clinicians can use the ICF 'core sets' which consist of a short list of ICF categories that are essential to describe the disability experience of the person with the specific health condition. The ICF assists professional to look beyond their own areas of practice, communicate across disciplines, and think from a functioning perspective rather than the perspective of a health condition. Research on use of the ICF is ongoing, not only for identifying people's health care and rehabilitation needs, but also for identifying effect of physical, social and policy environments in their lives.

Implications for Practice and Policy

Given that disability is best defined using a biopsychosocial framework, it follows that rehabilitation cannot only be achieved through clinical care. The WHO defines **rehabilitation** as a "set of measures that assists individuals who experience, or are likely to experience, disability to achieve and maintain optimal functioning when interacting with their environments." In addition to healthcare, community-based rehabilitation is often necessary; whereby, care is implemented through the combined efforts of people with disabilities, their families and communities, governments, education, vocational, social and other services. Indeed, a recent systematic review points to the need for a 'whole-systems approach' to prevent or reduce disability with the involvement of all key stakeholders—health care providers, patients, employers, workplaces, community workers, and policy makers. Thus, the evidence calls for a potential redesign of the policies and management of low back pain and other spinal disorders.

Concluding Remarks

It takes a village to create disability, and thus, it takes a village to prevent disability and rehabilitate people with disability. Rehabilitation requires more than providing health care to address one's specific impairments; it requires removing barriers in their environment—physical, social, and attitudinal barriers. By using the ICF tools, which organize information on functioning and disability, and recognize the role of environmental factors in addition to health conditions in creation of disability, and by taking a whole-systems approach, we can facilitate reducing the global burden of spine disability.

BIBLIOGRAPHY

1. Bartys S, Frederiksen P, Bendix T, Burton K. System influences on work disability due to low back pain: An international evidence synthesis. Health Policy 2017 Aug; 121(8):903–912.
2. Finger ME, Selb M, De Bie R, Escorpizo R. Using the International Classification of Functioning, Disability and Health in Physiotherapy in Multidisciplinary Vocational Rehabilitation: A case study of low back pain. Physiother Res Int 2015 Dec; 20(4):231–241.
3. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, Hoy D, Karppinen J, Pransky G, Sieper RJ, Underwood M. What low back pain is and why we need to pay attention. Lancet 2018 Jun; 391(10137):2356–2367.
4. The ICF: An overview. Available at: *https://www.wcpt.org/sites/wcpt.org/files/files/GH-ICF_overview_FINAL_for_WHO.pdf* Accessed January 5, 2019.
5. World Health Organization. The International Classification of Functioning, Disability and Health (ICF). Geneva: WHO. *http://www.who.int/classifications/icf/en/*. Accessed January 3, 2019.
6. World Health Organization. Disability. Geneva: WHO. *https://www.who.int/disabilities/en/*. Accessed January 3, 2019.
7. World Health Organization. Rehabilitation. Geneva: WHO. *https://www.who.int/rehabilitation/en/*. Accessed January 3, 2019.

Spine Disability in Cerebral Palsy

Prof Dr Ashok N Johari
Editor-in-Chief
Journal of Pediatrics Orthopaedic B
President; Asia Pacific PaediatricOrthopaedic Society (APPOS)
President; World Association against Infection in Orthopaedics and Trauma
Children's Orthopaedic Centre
Mumbai, India

Spinal disability in cerebral palsy (CP) is seen as a break in the neural arch, cervical and lumbar stenosis, scoliosis and kyphosis. Neuromuscular scoliosis is a spinal deformity caused by a dysfunction of the central/peripheral nervous system. Involvement of the central nervous system (CNS) in CP results in muscle imbalance. Muscle imbalance or lack of use of muscles could cause spinal deformity and lack of spinal stability. Neuromuscular scoliosis presents early and progresses rapidly as these problems are present since birth. Progression is irrespective of skeletal maturity, as in other forms of scoliosis, where progression stops following cessation of the child's growth. As per Heuter Volkmann Law, due to unequal pressures on the spine, areas of high pressure demonstrate growth inhibition while areas of low-pressure show growth acceleration. This leads to rapid progression in scoliosis. The characteristic features of neuromuscular scoliosis are largely progressive and stiff curves. The muscles are not used, the bones get deformed and the curvature is stiff. The curves are long as long segments of the spine are involved. Additionally, pelvic obliquity is observed along with the sagittal plane deformity.

In cerebral palsy, the asymmetrical tone is observed in the para-spinal and intercostal muscles due to the presence of persistent primitive reflex patterns, deficient neuromuscular control and lack of corrective forces. Scoliosis can be more pronounced and then there are no compensatory curves to bring the shoulder and head over the pelvis.

The incidence of scoliosis, in spastic CP, is 50%, in athetoid CP is about 25%, in the ataxic CP, it is 5%. The incidence and severity of the spinal deformity parallels the extent of neural involvement. Children with higher Gross Motor Function Classification System (GMFCS) levels 4 and 5 and higher neurological involvement show greater deformity. In the most severely affected quadriplegic patients, spinal deformity exists in about 75% of the cases, which is a very high percentage. In the less involved ambulatory diplegics and hemiplegics, this varies from 6% to 10%.

Consequences or Disabilities because of Spinal Deformity in Cerebral Palsy

Spinal deformity leads to compromised functional abilities. There is difficulty in sitting due to the imbalance of the spine, easy fatigability, long curves which include the sacrum and pelvic obliquity, giving rise to unequal pressures on the ischium. Functional quadriplegia is observed in people where the person has to use both his hands to support himself to stay upright.

Pelvic obliquity places unique challenges. It is defined as a mal-alignment in the spine and the pelvis in any plane. The pelvis may be rotated, tilted anteriorly or posteriorly or can be tilted in the coronal plane. The causes are related to the hip and the spine. Infra-pelvis cause, like an abduction contracture at the hip joint may give rise to pelvic obliquity. The person tries to get the lower limbs neutral, that side of the pelvis will drop down because of the tight abductors. Supra-pelvic cause of the obliquity is associated with dysfunction in the spine and is obvious on sitting. Pelvic obliquity can be categorized based on its magnitude. So, when the pelvis is leveled, it is categorized as P0, when there are up to 10 degrees of obliquity, it is termed P1, between 10 and 25 degrees, it is P2 and more than 25 degrees is termed P3.

Problems of Pelvic Obliquity

The consequences of pelvic obliquity could be iliocostal impingement where the rib cage actually sinks into the pelvis. The hip is uncovered on one side where the pelvis is high. Adduction of the pelvis in standing leads to limb length discrepancy. The limb on the lower side of the pelvis appears longer and the person stands with the knee in flexion. Due to pelvic obliquity, on the higher side, hip adduction is seen and the hip tends to become unstable and starts subluxating which requires the hip to be corrected first. The spinal deformity may reduce after the hip is corrected. Regular monitoring is necessary because of the progression potential of the neuromuscular curves.

Classification of Scoliosis in Cerebral Palsy

A level pelvis is called Group 1, when there is pelvis obliquity, it is termed Group 2. *A* is somewhat compensated, *B* is totally uncompensated, *C* is somewhat compensated, *D* is totally uncompensated.

Natural history: Curves > 40 degrees by the age of 15, are generally progressive. Progressive curves are observed in people with total body involvement, GMFCS level 4 and 5, quadriplegia patients, patients with poor mobility and thoracolumbar curves.

Treatment

Indications for active treatment are the presence of progressive deformity and pelvic obliquity, problems with sitting, problems with functioning and ambulation.

Goal of Management

- To have a proper and independent sitting balance on a level pelvis and a straight spine.
- To relieve fatigue
- To relieve pain due to iliocostal impingement
- To stabilize the pulmonary function
- To free arms for activities

Factors that Need Consideration

Some general issues with the cerebral palsy patient, the poor state of health, compromised respiratory function, poor nutritional status, poor bone quality, and low-grade urosepsis or urinary infection. Technically, the surgeries are complex because of poor bone quality, extensive instrumentation required, intra and post-operative respiratory management is an issue and increased blood loss. All neuromuscular scoliosis bleed extensively. Some factors require consideration before surgery—how big is the curve, what is the pelvis level, what is the trunk balance like, what is the sitting tolerance, what is the lung function, what is the mental state, what is the general health, etc.

The preoperative evaluation is multi-systemic—respiratory, cardiac, nutrition, feeding difficulties, gastrointestinal problems, seizure disorders, epilepsy, and metabolic bone disease. Operative consideration for the surgeons is managing the blood loss, neurologic monitoring, not to worsen the patients and intra-operative hypothermia. Correction is desired in the 3 dimensions, thus demanding strong internal fixations and minimal pseudarthrosis.

Available surgical options for growing children, where spinal fusion is not desirable, include growth rods. For early onset scoliosis, definitive fusion is recommended. Instrumentation with fusion in front of the spine and back of the spine is desired in very severe cases. Growth rods are magnetic, non-self-expandable rods which allow periodic expansion via surgery, every 6 months. They are implanted and elongated from outside via remote control. They are useful in growing children to accommodate an increase in height.

Definitive fusion is indicated for severe curves for people who are near skeletal maturity. It involves spinal fusion, straightening of the spine, leveling of the pelvis by correcting the lumbar spine. The fusion does not extend to the pelvis. In cases with severe pelvic obliquity, definitive fusion can extend to the pelvis.

Does this surgery benefit the patient?

Research papers report that surgery is beneficial in these cases and the verdict is large, yes. In terms of handling the patients, in terms of sitting capacity and functional ability, they are definite improvement following surgery. 71% have improved quality of life. The surgeries are complicated, however, parents still feel that it is worthwhile doing the surgery and associated with an improvement in the carer-assessed quality of life and pain. It needs to be emphasized that developmental scoliosis involves multiple components—spine, pelvic obliquity, and simultaneously hip issues. It is very important for clinicians to realize that as they look at the most obvious problems, there is another problem which is lurking in the background.

Adult Scoliosis

In cerebral palsy, 60% of adults also have scoliosis in the same category, GMFCS 4 and 5. Progression with aging can occur at 1 degree per year and should be monitored carefully over time. Progression can be accompanied by loss of function. Pain becomes an issue because of facetal degeneration on the concave side due to the pressure. Soft tissue strain on the convex side may be amenable to custom molded seating and thoracolumbar orthoses. In conclusion, timely treatment of scoliosis prevents morbidity and enhance quality of life.

SYMPOSIUM IV

Burden of Spine Disorders: Global and Indian Scenario

Global Burden of Spinal Pain: What do we Know?

Keynote Address

Pierre Côté
Canada Research Chair in Disability Prevention and Rehabilitation
Faculty of Health Sciences, Ontario Tech University
UOIT-CMCC Centre for Disability Prevention and Rehabilitation
Oshawa, Ontario, Canada

Every year, more and more people around the globe suffer from spine disorders related disability.[1,2] In fact, low back and neck pain are leading causes of disability globally. This is very concerning because most people with disability live in low- and middle-income countries and because disability is a barrier to accessing health care, education and employment. The purposes of this paper are:

1. To explore the global burden of spine relate disability and "zoom in" on Canada and India, and
2. Reflect from a clinical and public health perspective on lessons learned regarding the prevention and rehabilitation of spinal pain and disability.

Between 1990 and 2015, the global prevalence of disability related to low back pain (measured as years lived with disability (YLD)) has increased by 17.2%.[3] During the same period, the global prevalence of disability related to neck pain (measured as years lived with disability (YLD)) increased by 21.0%.[3] Disability related to spinal pain recognizes no borders. In fact, low back pain is the leading cause of disability on most continents excepts for pockets in Africa, India and south-east Asia.[2] In those regions, leading causes of years lived with disability include HIV/AIDS, dietary iron deficiency and digestive disorders.[2] Since 1990, low back pain has consistently been the main cause of disability in males regardless of a country's socio-demographic index (a composite measure of income per capita, average educational attainment and fertility rates).[2] However, the picture is different for females. Between 1990 and 2017, females who live in countries with lowsocio-demographic index are more likely to be disabled by dietary iron deficiency and headaches, but the burden of disability related to low back pain increases as a country's socio-demographic index increases.[2] This suggests that a larger proportion of the world's population will be disabled by low back pain as low- and middle-income countries become more prosperous.

Comparing Canada and India is helpful to understand the pandemic of disability related to low back pain. According to the Institute for Health Metrics and Evaluation, the burden of disability related to low back pain (measured as the annual rate of years live with disability (YLDs) has slowly increased in both countries since 1990.[4] In Canada, the rate of disability related to low back pain has increased from 1,601/100,000 person/year in 1990 to 1,749/100,000 persons in 2017. During the same period in India, the rate of disability related to low back pain has increased from 525/100,000 persons in 1990 to 570/100,000 persons in 2017.[4] However, in both countries, the rate of disability has remained consistently higher in females than males. The fact that Canada has a rate of disability related to low back pain that is 3 times higher than India raises important and serious questions

about the societal etiology of back pain disability. Although differences in age of the two populations accounts for some of the differences, most of the burden at the population level may be related to socio-demographic development of the countries. In 2017 Canada has a GDP that was 6.9 times superior to India and twice the educational attainment (years of education).[4] Importantly, the health care expenditures per person were 20 times higher in Canada than in India.

The current evidence suggests that current health care strategies are ineffective in preventing and rehabilitating disability related to spinal pain.[5] In fact, the only intervention that may be effective in preventing low back pain is exercise and education. Moreover, investing in interventions such as back schools, assistive devices and ergonomic modifications of workplaces have yielded disappointing results and have been showed to be ineffective. Similarly, reliance on passive clinical interventions (such as TENS), repeated health care visits, or medication (such as Tylenol or opioids) to manage low back pain disability may have exacerbated to problem by creating iatrogenic disability.[5–8] The failure of currently available prevention and rehabilitation interventions to reduce the burden of disability related to spine disorders may be related to our conceptualization of back and neck pain. Spinal pain rarely occurs in isolation and it tends to be associated with multiple comorbidities such as depression, headaches and digestive problems.[9,10] Therefore, new and innovative approaches to the rehabilitation of spine disability must adopt a holistic and patient-centered approach to clinical care that avoids ineffective interventions and focus on self-management and management of comorbidities (including mental health).

Clinical care alone is unlikely to reduce the burden of spina disability in the population. Clinical strategies must be combined with community-based rehabilitation (CBR). According to the World Health Organization (WHO), community-based rehabilitation is *"a strategy within general community development for rehabilitation, equalization of opportunities, poverty reduction, and social inclusion of people with disabilities. CBR is implemented through the combined efforts of people with disabilities themselves, their families, organizations, and communities, and the relevant governmental and non-governmental health, education, vocational, social, and other services."* [11] Our best hope to reduce the burden of disability related to spine disorders is to develop a global strategy by tackling personal, psychosocial and environmental causes of disability through evidence-based health care and public health interventions.

REFERENCES

1. Vos T, Allen C, Arora M, Barber RM, Bhutta ZA, Brown A et al. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990–367 2015: a systematic analysis for the Global Burden of Disease 368. Study 2015. Lancet 2016; 388:1545–1602.
2. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392: 1789–858.
3. Hurwitz E, Randhawa K, Yu H, **Côté P**, Haldeman S. The Global Spine Care Initiative: A Brief Summary of the Global Burden of Low Back and Neck Pain studies. Eur Spine J26 February 2018. doi: 10.1007/s0058.
4. The Institute for Health Metrics and Evaluation (IHME). *http://www.healthdata.org*. 2019.
5. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, Ferreira PH, Fritz JM, Koes BW, Peul W, Turner JA, Maher CG and *Lancet Low Back Pain Series Working Group*. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018;391:2368–2383.
6. Côté P**,** Hogg-Johnson S, Cassidy D, Carroll L, Frank JW, Bombardier C. Initial patterns of clinical care and recovery from whiplash injuries: A population-based cohort study. Arch Intern Med. 2005;165:2257–2263.
7. Cassidy JD, Carroll LJ, Côté P**,** Frank J. Does multidisciplinary rehabilitation benefit whiplash recovery? Results of a population-based incidence cohort study. Spine. 2007;32:126–131.
8. Chou R, Côté P, Randhawa K, Torres P, Yu H, Nordin M, Hurwitz E, Haldeman S, Cedraschi C. The Global Spine Care Initiative: Applying evidence-based guidelines on the non-invasive management of spinal disorders to low and middle-income communities. Eur Spine J, 2018 (Suppl 6):851–860.
9. Côté P, Cassidy JD, Carroll L. The factors associated with neck pain and its related disability in the Saskatchewan population. Spine. 2000;20:1109–1117.
10. Carroll L, Cassidy JD, Côté P**.** Depression as a Risk Factor for Onset of Troublesome Neck and Low Back Pain. Pain. 2004;107: 134–139.
11. World Health Organization. World Report on Disability. Geneva: WHO Library Cataloguing-in-Publication Data; 2011.

Burden of Spinal Disability in India: Southwest Maharashtra

Rajani Mullerpatan
Director-Professor

Yuvraj Singh
Lecturer

Shweta Nahar
MPT Scholar
Department of Physiotherapy
MGM Institute of Health Sciences
Kamothe, Navi Mumbai, India

Among non-communicable disorders; low back and neck pain are the most common causes of disability.[1,2] Estimates from the 2016 Global Burden of Disease (GBD) study report that back pain affects more than half a billion people worldwide and more than one-third of a billion people are affected by neck pain.[2] The largest increase in disability caused by low back pain in the past few decades has occurred in low-income and middle-income countries. In India, 74% of the population lives in rural areas. Tribal people make up 8.6% of India's population.[3] There is a paucity of literature exploring spine pain and associated disabilities in these 2 communities where informal employment is common and possibilities for job modification are almost absent. We explored point prevalence of low back and neck pain in a rural area of Maharashtra, India and described attitudes and beliefs of rural people towards spine pain and disability. This information will help to develop customized spine care programs driven by community-engaged partnerships and self-empowerment for the local community.

A cross-sectional study was conducted in 3 rural and 3 tribal villages in the coastal district of Raigad of Maharashtra between 1st August 2016 and 31st October 2016. Maharashtra is a state spanning across the west-central region of India. The MGM Institute of Health Sciences (Deemed to be University) Navi Mumbai, India provides basic health care services to the rural and tribal people of Raigad district through the MGM Rural Health Centre located at Tara Village. These villages are governed by the local body of Karnala *Grampanchayat* (village administrative body). The cross-sectional study was followed by a non-formal group discussion with patients with back and neck pain in the rural village of Tara. The three villages studied were Tara (population = 1372), Barapada (population = 1979) and Kalhe (population = 775). The three tribal areas were Khairatwadi (population = 135), Banubaichiwadi (population = 250) and Vitthalwadi (population = 225). The cross-sectional study included males and females aged 18 to 75 years who voluntarily agreed to participate. Participants were recruited using a door-to-door survey method and inquired about the presence of low back or neck pain. People with spine pain living in the house were interviewed by a trained physiotherapist with an indigenously developed spine pain questionnaire.

Data was collected using indigenously developed Spine Pain Questionnaire which included sections exploring nature of pain, activity limitations and attitudes and beliefs. Following the survey, one non-formal group discussion was conducted in Tara village with individuals with spine pain. The informal group discussion was proctored by a senior physiotherapist and the session lasted for approximately 35 minutes. The discussion focused on participants' perception towards pain, attitudes and beliefs in details with points highlighting home remedies for spine pain, outreach sources for treatment of spine problems and opinions regarding establishment of local spine care clinic.

Point prevalence and 95% confidence interval (CI) was computed as the proportion of individuals who reported neck or low back pain on the day of the survey divided by the total number of participants present in the village during the survey. Video files were recorded for the non-formal group discussion after consent. A panel of 3 coders examined transcripts reflecting what occurred during the discussion and coded them. The codes were then grouped to create the following themes: a source of information, problem-solving strategies, adaptation strategies and barriers to recovery.

Our sample included 2323 participants. Among rural people (n = 2073), the point prevalence of low back and neck pain was 4.9% [95% confidence interval = 3.9 to 5.8] and 2.9% [95% confidence interval = 2.2 to 8.9] respectively. Among tribal people (n=250), it was 10.0% [95% confidence interval = 6.3 to 13.7] for low back pain and 3.6% [95% confidence interval = 1.3 to 5.9] for neck pain.

Among the total participants 95/101 (94%) rural participants and 23/25 (92%) tribal participants reported chronic low back pain (pain >3 months). Similarly, 53/61 (87%) rural participants and 6/9 (66%) tribal participants had chronic neck pain (pain >3 months in duration). Secondly, 81% rural and 60% tribal people with low back pain were symptomatic for more than one year; and 77% rural and 44% of tribal people with neck pain had symptoms for more than one year. Participants in the middle age group (41–55 years) reported the highest prevalence (43% to 53%) of spine pain for more than one year; followed by young adults (18–40 years) age group (34% to 50%) and was observed to be least in older (56–75 years) age group (0%–23%).

Lifting heavyweights and trunk bending were the most restricting activities. Most villagers attributed spine pain to traditional lifestyle and age. Participants continued to work in the presence of pain. Home remedies such as hot fomentation and ayurvedic oil massage were the first line of care for spine pain. Lack of transport facilities and the cost of treatment emerged as the two most common reasons for delaying treatment at hospitals or clinics in nearby towns. People sought medical care only when the pain was severe and prevented them from working on the farms; however, they continued to perform household tasks.

Findings from our study strongly warrant an urgent need of establishment of a dedicated Spine Care Clinic which will prioritize spine care for the tribal and rural population. The clinic should be accessible, connected by good transport network and operate at a suitable time of the day which is convenient to people as they are required to work during daytime for daily wages. Education and awareness about spine care aimed to change beliefs of rural and tribal people about causes of spine pain and the positive role of exercises is required. There is a need to train a local health practitioner in spine care or appoint a primary spine care practitioner who can visit the clinic regularly to screen 'red flags', refer them to nearby secondary or tertiary hospital. Voluntary health workers trained in evidence-based yoga therapy could contribute to overall spine care as yoga is acceptable culturally. To our knowledge, it is the first study performed in the village and tribal area of west zone of India and reported around the same time that Lancet calls for global action on low back pain in low to middle-income countries because of the years lost to disability.[4]

CONCLUSION

The prevalence of low back and neck pain in the rural population was 4.8% and 2.9% respectively. In the tribal population, the prevalence was 10% for low back and 3.6% for neck pain. Lifting heavyweights and forward neck and trunk bending were the most restricted activities. Point prevalence of chronic low back pain (94% in rural and 92% in tribal) and neck pain (87% in rural and 66% in tribal) were higher than previously reported global estimates. Prevalence of chronic spine pain was highest (43% to 53%) among middle-aged people (41–55 years) followed by young adults and then elderly people. People sought medical treatment only on acute exacerbation of symptoms or when the condition turned chronic. Most people attributed spine pain to age and traditional physically demanding lifestyle at work and at home. Home remedies were the first line of care for spine pain. Lack of transport facilities and loss of daily wages from work absenteeism, emerged as two most common reasons for delaying treatment at the rural health centre.

REFERENCES

1. Global Burden of Disease Study 2013 Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013.Lancet 2015 Aug; 386(9995):743–800.
2. Hurwitz E, Randhawa K, Yu H, Côté P, Haldeman S. The Global Spine Care Initiative: a summary of the global burden of low back and neck pain studies. Eur Spine J 2018 Sep; 27(Suppl 6): 796–801.
3. Census 2011 India [Internet]. Census2011.co.in. 2011 [cited 21 September 2018]. Available at: https://www.census2011.co.in/
4. Buchbinder R, van Tulder M, Öberg B, Costa L, Woolf A, Schoene M, Croft P, Lancet Low Back Pain Series Working Group. Low back pain: a call for action. Lancet 2018 Jun; 391(10137): 2384–2388.

Burden of Spinal Cord Disability in Nepal

KS Gurung
Senior Consultant and Physiotherapist
Green Pastures Hospital and Rehabilitation Centre (*GPHRC*)
Pokhara, Nepal

Disability following spinal cord injury is a challenge to all physiotherapists. Both developed and developing countries face problems caused by spinal cord injury. However, the cause and level of the burden they face vary. According to a study, the major cause of spinal cord injuries in Nepal is fall injuries (68.24%), road traffic accident (18.63%), buried by mud (7.87%) and others (5.25%). Most injuries occur at the level of thoracic vertebrae (49.34%). Many of these cases fail to receive basic management such as neck and spine immobilization at the time of injury.

INTRODUCTION

Spinal cord injury (SCI) is damage to the spinal cord or cauda equina which may lead to permanent or temporary motor, sensory or autonomic dysfunction. Injury can occur at any level of the spinal cord and can be complete, with motor and sensory loss of function or incomplete, i.e. some functions are preserved. The severity of disability depends on the level and severity of damage to the cord. Symptoms of SCI vary from numbness and paresis to paralysis. Long-term prognosis also ranges from full recovery to permanent paralysis to complications such as pressure ulcers, muscle atrophy, and incontinence. Injury to the cervical spine may lead to quadriplegia, whereas injury to the thoracic spine results in paraplegia. Injury to lumbosacral spine leads to incontinence and decreased control of lower limbs.

SCI is almost always caused by physical trauma. In the majority of the cases, the injury is caused by road traffic accidents, fall injuries, gunshot injuries, sports injuries, and natural disasters. The non-traumatic causes are infections, malignancies or can be iatrogenic.

The treatment of SCI starts with the prevention of such injuries. Precautionary measures such as adopting safety equipment and regulations are important. Medical treatment starts with the restriction of movement of the spine (immobilization) and bed rest with surgical intervention when required. Long-term treatment involves physiotherapy and occupational therapy to improve quality of life and prevent further complications.

Spinal Cord Injury in Nepal

In contrast to developing countries where major cause of SCI is car accidents, the major cause of spinal cord injuries in Nepal is fall injury followed by road traffic accidents. Fall from height or fall with heavy load on back leads to SCI related disability in Nepal.

According to a study[1], the etiology of SCI in Nepal was as follows:

Cause of spinal cord injury	Percentage
Fall injuries	68.24%
Road traffic accidents	18.63%
Buried by mud (from natural disasters)	7.87%
Others (Iatrogenic, Systemic illness, tumors)	5.25%

Most common spinal cord injury among these was at the level of thoracic vertebrae (49.34%) followed by lumbar (29.66%) and cervical (17.84%). The least affected region was the sacral region (3.15%). According to the same epidemiological survey, higher incidence of spinal cord injury was reported in males (73.50%) than in females (26.50%). Age at which SCI occurred was between 21 and 30 years (30.50%). Over 59.58% of people had to undergo surgery while others were treated conservatively (40.42%).

Agewise distribution of SCI in Nepal

Age group	*2008*	*2009*	*2010*	*2011*	*Total (%)*
Less than 20	10	13	11	18	52 (13.12)
21–30	27	25	27	37	116 (30.45)
31–40	20	21	24	23	88 (23.10)
41–50	14	19	13	27	73 (19.16)
51–60	5	8	7	10	30 (7.87)
More than 60	5	7	7	7	22 (5.77)

Burden of Spinal Cord Injury in Nepal

Spinal cord disability still possesses a great burden on a developing country like Nepal. Currently, the challenges of treating a case of spinal cord injury include lack of appropriately skilled manpower, lack of funding or expenses, political instability and absence of standard centre and protocol. Many cases are treated in Nepal. However, most of them did not receive adequate and appropriate treatment and rehabilitation.[2] Lack of high skilled professionals and well-equipped center adds to the burden of spinal cord deformity. The limitations to managing a case of spinal cord injury include a lack of resources, the poor financial condition of the majority of Nepalese people along with increased-expenses in spinal surgery, lack of incentives and unwillingness of professionals to work in remote settings, lack of skilled first responders and lack of first aid education, centralization of manpower, political instability and frequent strike, inadequate training and lack of standard protocols and guidelines and lack of awareness among patient and family members.

Challenges to prevent spinal cord injury occurring in the first place are a failure to adopt safety measures and simple precautions. After sustaining injury adequate measures to protect the spinal cord were not met. According to a study from eastern Nepal, 81% of patient of spinal cord injury were brought to hospital without spinal or cervical immobilization. Delay in seeking and receiving treatment following an injury to the spinal cord was there due to lack of awareness and lack of nearby tertiary centers. Challenges were also faced as the most patient could not afford treatment. Rehabilitation following treatment wasn't successfully completed due to financial constraints. Disability following an injury to spinal cord lead to poor quality of life in most patients and efforts to improve the condition of patient could not be met due to lack of manpower and resources.

However, physical rehabilitation is going strong in Nepal. Many patients receive early rehabilitation in the hospital itself so they can adjust to the community early and improve their quality of life. Patients are offered rehabilitation when they are medically stable and can tolerate the intensity of rehabilitation. Standard guidelines like ASIA Score and SKIME are being adapted to provide appropriate treatment. Physiotherapists are working to help make patient capable to

daily activities such as dressing up, eating, using the toilet, etc. and make a recommendation for home modification and other equipment needs. Mobility aids are now available such as wheelchairs to make patient independent and help them ambulate themselves from one place to another. Functional outcome following spinal cord injury is improving in Nepal but still Nepal faces a lot of barriers and limitations on treating the patient with spinal cord injury.

DISCUSSION

Fall injuries still remain the major cause of SCI disability in Nepal. Preventive measures should be applied and rehabilitation must be initiated in all patients. Treatment of SCI should include:

- Addressing immediate symptoms; airway management, feeding and toilet problems
- Palliative care for pain management
- Lifestyle modification; healthy diet, stop smoking
- Physical therapy; early mobility
- Patient and family member counseling to help them cope with SCI disability
- Surgery to correct SCI-related health problems
- Prevention of complications: Bed sores, toilet training, feeding issues

Challenges faced in treatment begin by addressing those problems directly. Government of Nepal should take a stand to improve the condition of many who are living with SCI disabilities. Easy accessibility to specialized centers must be made so early treatment can effective. Provision for the training of SCI should be made and incentives should be provided to both spinal cord injured and health professional so the burden of SCI can be reduced effectively.

REFERENCES

1. Shrestha P, Shrestha S, Sherstha RK. Retrospective study of spinal cord injured patients admitted to spinal injury rehabilitation center, Sanga, Banepa, Nepal. Nepal Med Coll J 2013 Dec;15(3):164–166.
2. Bajracharya S, Singh M, Singh GK, Shrestha BP. Clinico-epidemiological study of spinal injuries in a predominantly rural population of eastern Nepal: A 10 years' analysis. *Indian J Orthop.* 2007 Oct-Dec; 41(4):286–289.

SYMPOSIUM V

Conservative Management of Spine

What is the Best Early Care for Low Back Pain, When is it Needed Based on Evidence?

Keynote Address

Margareta Nordin
Research Professor
Departments of Orthopedic Surgery and Environmental Medicine
Occupational and Industrial Orthopedic Center (OIOC)
New York University
New York, NY, USA

Pradnya Girdhar
Lecturer
MGM School of Physiotherapy
Kamothe, Navi Mumbai, India

INTRODUCTION

Disability due to low back pain is a significant global health and cost concern.[1–3] About 1.2 billion people are affected by low back pain and become disabled costing the United States about US $50 billion, the United Kingdom US $11 billion and the Netherlands about US $5 Billion/year.[3] Back pain and disability disproportionally affect women, the elderly, rural communities and the lowest income population (*https://www.who.int/disabilities/world_report/2011/report.pdf)*

In recent large systematic reviews[3,4] there were calls for action for better policies and the importance of implementing current evidence-based care to reduce disability of low back pain.

Disability from low back pain is a complex interaction between the individual and their social context. The medical model used primarily for infectious disease has not been successful to prevent low back pain disability. Currently, there is "no cure" for common low back pain but there are promising results for the prevention of back pain disability with low-cost methods and patient empowerment in early care and self-care.

The biopsychosocial model for common low back pain acknowledges the distress for patients by the education of the patient and the health care environment. The model considers that psychological and social factors are important components to addressing prevention of disability for low back pain and health care providers play an important role in empowering patients to take control of their spinal health outcomes.

Patients should be included in negotiating their spinal treatment and establishing treatment goals through careful listening, reassurance, and information providing by the health care provider. The model has promising results but has not been upscaled to compensation and healthcare systems-wide approaches in many countries, therefore, the results for low back pain management is suboptimal.

There is robust evidence to suggest that specific, unhelpful characteristics of compensatory systems are obstacles to work and community participation. For the healthcare system, there is robust evidence to suggest that a lack of work and activity-focused healthcare (i.e. a failure by healthcare professionals to address activity and work issues within the clinical encounter) is an obstacle to community participation. In addition, the healthcare system lacks to provide access to suitable, evidence-based satisfactory care. Finally, there is some evidence that lack of support from significant others delays returns to activity for the prevention of spine disability.

There is a need for change[2–4] and health care providers can contribute to this change by using the biopsychosocial model, be communicating with all stakeholders (patient, employers and compensation system), by providing evidence-based care, endorsing a return to work and activity and prevention of disability as a health outcome measure and success of management for low back pain. The purpose of the extended abstract is to introduce a low-cost an evidence-based model for early spine care in underserved populations managed by allied health care professionals as a port of entry in underserved populations to alleviate disability from back pain. The model is based on integrative and continued care in the community with the support of academia or local government.

Evidence based Recommendations for Low Back Pain of the Non-specific Character

The patient seeking care with low back pain have been extensively researched. The guidelines for acute low back pain (<3 months duration) and chronic low back pain (>3 months duration) recommend low-cost interventions using the biopsychosocial model.[4,5] Most individual seeking care will recover however about 30% will experience chronic back pain and recurrence of bouts of low back pain is high and related to the type of work and type of activity. Figure 5.1 shows the accumulated evidence for the best treatment for acute and chronic common low back pain.[5] The efficacy of the recommendations is moderate to good and the treatment is focused on empowering the patient by education, reassurance and to maintain activity to manage their low back pain, exercise and keeping a healthy lifestyle. When treatment is needed, it is recommended to be of short duration about 4–6 treatments sessions are usually enough by a physical therapist. Low back pain of chronic duration (>3 months) fair best of a combination treatment of activity, exercise and education with cognitive behavioral support according to the biopsychosocial model.[5,6]

At the first encounter with the patient clinical history and evaluation (orthopedic and neurological) is strongly recommended to evaluate for red flags, i.e. serious disease, trauma, cancer, infectious and inflammatory disease[7] and psychosocial factors that may delay recovery (i.e. anxiety, catastrophizing, fear of movement and others).[5] Once the diagnoses of non-specific low back pain is ascertained the treatment choice in consultation with the patient can be established. All patients require education and reassurance of the course and prognostic of low back pain, best evidence-based treatment and what to expect. Most worries exhibit by a patient can be handled by the clinicians, a few patients may need additional structured education and reassurance and/or cognitive behavioral treatment in the chronic stage (Fig. 5.1).

Treatment acute <3 months	*Treatment chronic > 3 months*
Patient education and reassurance	Structured education and reassurance
Stay active	Exercise (walking, yoga, patient preference)
Manipulations	Manipulation or mobilization
Muscle relaxants	Clinical or relaxation massage
	NSAIDs drugs
	Needle acupuncture
	Multimodal (significant distress or disability)
	a. Exercise
	b. Cognitive/behavioral approaches

Fig. 5.1: Recommendations of efficacy from systematic reviews and guidelines for the treatment of non-specific low back pain

For those patients with chronic non-specific low back pain, evidence from randomized controlled trials show that surgery provides no additional benefit in pain or function compared with conservative care, while presenting a low but the real risk of complications.[8] The suggested treatments above are cost effective according to the Institute for Clinical and Economic Review (ICER) (https://icer-review.org/material/back-and-neck-pain-raag).

DISCUSSION

Low back pain of non-specific character includes about 80% of the population in the world sometime during the lifetime of an individual. The Global Burden of Disease (GBD) 2018 and the Global Spine Care Initiative (GSCI) 2018 came to a very similar conclusion about prevalence estimates and the burden of low back pain disability for the individual, the family, and the community.[1–3] The burden is enormous around the world and global action is needed.[2,3] Public health has failed to address the problem and that must change through public education and community action. Low back pain can be handled by allied health care professionals such as physical therapists, osteopath, chiropractors and other allied health care professional when trained by educating communities in healthy lifestyle, the exercise of preference and perform early triage and care. If an individual is seeking care, the care should be based on evidence, low cost and a continuum if a serious spine condition is diagnosed with a referral network established in the community when possible. A patient exhibiting red flags may need immediate care, for example, for a cauda equina syndrome, active tuberculosis, fracture or other. The community must be able to meet the demands and adapt these demands to the community population. The WHO recommends a positive policy environment, where the community and the healthcare organizations work together to develop a plan as a continuum to prevent disability (Fig. 5.2). The community partners and health care teams need to be informed, motivated and develop a plan of action to reduce disability from low back pain and spine disorders by including patients and family for best results based on evidence and a structured approach. This model of care gives value for society.

WHO further states that "In many countries, continuity and coordination depend heavily on the contribution of informal caregivers and family support. This is particularly true in low- and middle-income countries and where there are shortages of health care workers and many dispersed, remote communities".[9] This WHO report focuses on the relatively ill-defined, under-researched concepts of continuity and care coordination, which are broad and interrelated. Continuity and coordination of care are therefore global priorities for reorienting health services to the needs of people in the effort to prevent disability of back pain.

In 2016 the MGM Institute of Health Sciences and University (MGM) and World Spine Care (WSC) established a formal agreement to work together to institute MGM WSC spine clinic at

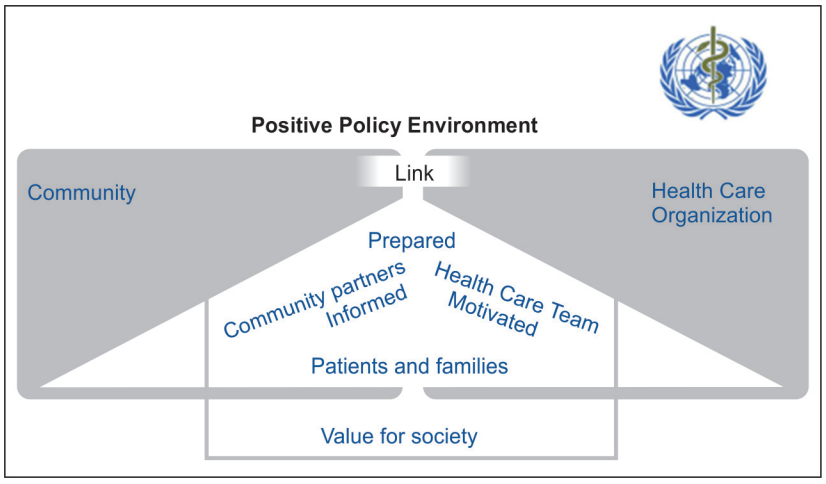


Fig. 5.2: The WHO model for care

Kamothe, Navi Mumbai for no-income and low-income underserved population surrounding the area. The clinic has received more than 2000 patients today, the evaluation and treatment are based on above evidence-based guidelines, recommendations and the WHO model to serve the community. The clinic is patient-centered, patient integrated, collaborative and coordinated with the community, the district care centers and the tertiary hospital. The primary clinic goal is to prevent disability of spine pain.

WSC's clinics, a practice example cited by WHO (9 [page 43]) from Botswana, has set up similar clinics in Botswana, Dominican Republic, and Ghana. All clinics are managed by dedicated physical therapists and/or chiropractors with an established link to district and specialty hospitals for urgent and/or specialty care when needed for the patient.

The model is working well and supported in each country by the government or an academic institution. The model needs validation and is culturally adapted for acceptance to function in different environments.

SUMMARY

Common low back pain is one of the largest and most costly challenges in today's healthcare and affects the workability, participation and quality of life for individuals and their families. Disability from low back pain affects about 1.2 billion individuals in the world. It disproportionally affects women, the elderly, rural communities and the lowest income population. Effective large-scale research is lacking to prevent disability from low back pain, however, WHO practice examples are of great help. The WSC evidence spine care model is proposed based on WHO recommendations and implemented in 4 underserved areas in Botswana, Dominican Republic, Ghana, and India, with promising results to serve underserved populations in the prevention of spine disability.

REFERENCES

1. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, Hoy D, Karppinen J, Pransky G, Sieper J, Smeets RJ, Underwood M. *Lancet Low Back Pain Series Working Group*. What low back pain is and why we need to pay attention. *The Lancet* 2018 Jun; 391(10137): 2356–2367.
2. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, Ferreira PH, Fritz JM, Koes BW, Peul W, Turner JA[1], Maher CG; *Lancet Low Back Pain Series Working Group*. Prevention and treatment of low back pain: evidence, challenges, and promising directions. Lancet 2018 Jun; 391(10137): 2368–2383.
3. Haldeman S, et. at. The Global Spine Care Initiative: World Spine Care executive summary on reducing spine-related disability in low and middle income communities. Eur Spine J 2018 Sep; 27(Suppl 6): 776–785.
4. Bartys S, Frederiksen P, Bendix T, Burton K. System influences on work disability due to low back pain: An international evidence synthesis. Health Policy 2017 Aug; 121(8):903–912.
5. Chou R, Côté P, Randhawa K, Torres P, Yu H, Nordin M, Hurwitz EL, Haldeman S, Cedraschi C. The Global Spine Care Initiative: applying evidence-based guidelines on the non-invasive management of back and neck pain to low- and middle-income communities. Eur Spine J2018 Sep; 27(Suppl 6):851–860.
6. Cedraschi C, Nordin M, Haldeman S, Randhawa K, Kopansky-Giles D, Johnson CD, Chou R, Hurwitz EL, Cote P. The Global Spine Care Initiative: a narrative review of psychological and social issues in back pain in low and middle-income communities. Eur Spine J2018 Sep; 27(Suppl. 6):828–837.
7. Nordin M, Randhawa K, Torres P, Yu H, Haldeman S, Brady O, Cote P, Torres C, Modic M, Mullerpatan R, Cedraschi C, Chou R, Acaroglu E, Hurwitz EL, Lemeunier N, Dudler J, Taylor-Vaisey A, Sonmez E. The Global Spine Care Initiative: a systematic review for the assessment of spine-related complaints in populations with limited resources and in low- and middle-income communities. Eur Spine J2018 Sep; 27(Suppl 6):816–827.
8. Mannion AF, Brox JI, Fairbank JC. Comparison of spinal fusion and nonoperative treatment in patients with chronic low back pain: long term follow-up of three randomized controlled trials. Spine J 2013 Nov;13(11):1438–1448.
9. World Health Organization. Continuity and coordination of care: a practice brief to support implementation of the WHO Framework on integrated people-centered health services. Geneva: World Health Organization; 2018. License: CC BY-NC-SA 3.0IGO. *Available at: https://apps.who.int/iris/bitstream/handle/10665/274628/9789241514033-eng.pdf?sequence=1&isAllowed=y*

The MGM-WSC Clinic for Underserved Population

Rajani Mullerpatan
Director and Professor
MGM School of Physiotherapy
Sector-1, Kamothe, Navi Mumbai 410 209
Maharashtra, India

Disability caused by low back pain in the past few decades has demonstrated the largest rise in low- and middle-income countries where informal employment is common and possibilities for job modification are almost absent. The focus of National Health Policies in most countries of Asia, Africa, and the Middle East is on infectious diseases due to the high mortality associated; overlooking the growing burden of disability caused by back and neck pain.[1]

Indian Council of Medical Research (ICMR, 2012) reported more than half of patients with musculoskeletal disease had low back pain[2]. In the general population in India, the prevalence of LBP was 6.2%. High prevalence of LBP is reported among farmers, nurses, heavy equipment operators, and construction workers. Causes, prognosis, and effectiveness of the treatment strategies adopted for spine pain have been ill-defined and hence many health professionals have misconceptions about them.

Spine care in India is managed largely at the tertiary care level in both public and private health care settings. It is more proactive in urban areas as compared to the rural areas. At primary health care (PHC) level, spine care is lacking completely in Navi Mumbai and Raigad districts of Maharashtra, India. Hence to deliver quality care and to reduce the burden of spine pain, MGM School of Physiotherapy formed MGM WSC Spine Clinic at MGM Hospital, kamothe, Navi Mumbai, in collaboration with World Spine Care which is a non-profit organization working to serve the underserved.

We aim to share the process of making of MGM's World Spine Care Clinic in Navi Mumbai city of Maharashtra state in India to offer evidence-based spine care to underserved people with spine pain. Such reports describing building/creating the framework of spine care is the need of today's community health care delivery to learn from preceding feasible methods with limited resources to deliver the best sustainable care.

From its inception in November 2016 till December 2018, the MGM WSC Spine clinic has been able to see a total of 2244 patients with the number of sessions being 5095. Approximately 65% of these patients were either successfully discharged as symptom-free or were put on a self-care program. The care pathway adopted by MGM WSC clinic is driven by the concept of 'little practitioner-driven activity' and placing greater emphasis on 'patient-driven activity'. Therefore the major components of the care pathway include exercises and self-care strategies; encouraging and guiding the patient to take responsibility for their health.

REFERENCES

1. Hurwitz EL, Randhawa K, Torres P, Yu H, Verville L, Hartvigsen J, Côté P, Haldeman S. The Global Spine Care Initiative: a systematic review of individual and community-based burden of spinal disorders in rural populations in low- and middle-income communities. Eur Spine J. 2018 Sep; 27 (Suppl 6):802–815.
2. Sharma R, Ed. Epidemiology of Musculoskeletal Conditions in India. New Delhi: Indian Council of Medical Research; 2012. 185p. Available at: *https://docplayer.net/17101913-Epidemiology-of-musculoskeletal-conditions-in-india.html*

SYMPOSIUM VI

Surgical Management of Spine

When is Surgery Needed for the Management of Spine Disorders?

Keynote Address

S Rajasekaran
Department of Orthopaedics and Spine Surgery
Ganga Hospital
Coimbatore-641043, Tamil Nadu, India

Globally there has been a tremendous rise in the number of spine surgeries performed over the last three decades.[1] However, most spinal disorders do not require surgery, and conservative modalities of treatment such as physiotherapy and medications play a significant role in the treatment of spinal ailments. Sophisticated diagnostic equipment resulting in over diagnosis of spinal disorders has further added to the drastic increase in surgery rates. The shift of rural population to urban cities, the expectation of patients and regional insurance policies have also influenced surgical rates in an indirect manner. Lifestyle changes, improvement in survival rates amongst cancer affected people, aging population and associated co-morbidities have further increased the number and complexity of spine procedures. Technical advances in spine surgery have helped surgeons to perform the most complex surgeries in a safe manner. However, spine surgery, unlike arthroplasty, results in variable outcomes and it is often noted that patient-reported outcomes are not as satisfactory as other standard surgical procedures.[2]

One of the most important reasons is that, spine includes multiple motion segments unlike the knee and hip and the pain generators in spinal disorders can be intervertebral disc, vertebra, facet joints, paraspinal musculature, osteoporosis, and sarcopenia. Recently, the Lancet has published a series of three articles from internationally renowned researchers, where they highlight the fact that there is a huge gap between evidence and practice and inappropriate use of imaging, rest, drugs and surgical interventions have resulted in persistent back-related disability, leading to long term consequences.[3]

There are definitive indications of surgical intervention which include five broad disorders—progressive deformities, destructive lesions, neurological compromise, degenerative pathologies and trauma. However, there is a huge grey zone in determining the surgical threshold in all these disorders and it is also common that surgical strategies, approach, and protocols vary immensely across spine surgeons.

Neurology and Vertebral Destruction

Universally, surgeons have reached a consensus on surgical indications in neurological consequences of spinal disorders which include the spectrum of severe radiculopathy, myelopathy, spinal cord injury, acute neurological worsening, cauda equina syndrome, compression secondary to infection or tumours, and claudication. Similarly, any spinal pathology causing extensive

vertebral destruction leading to pathological collapse, deformity and instability are accepted as a reasonable indication for surgical intervention.

Degenerative Spine Pathology

Regional variations in thresholds and type of spine surgery are highest amongst the spine surgeons. For the 39 countries, rates of surgery for low-back pain ranged from 11.5/100,000 to 172.1/100,000; this is nearly a 15-fold difference between highest and lowest rates.[4] Vague guidelines in surgical treatment drive surgeon preferred approaches and thereby variable outcomes for the same spinal ailment. The most important factor in the treatment of low back pain is making a specific and appropriate anatomic diagnosis. There is tremendous variability of surgical choice even for the most common spinal disorders of herniation, stenosis, and spondylolisthesis. The Spine Patient Outcomes Research Trial (SPORT) was initiated in March 2000 to compare the outcomes of surgical and non-operative treatment in the above three conditions and give conclusive evidence of good outcomes only in stenosis.[5] Adding to these unsolved questions the last decade has witnessed an immense increase in fixation of surgical levels in degenerative adult scoliosis in order to restore sagittal balance leading to a huge number of complications. The demands of spinal alignment are not restricted to standing posture alone which has been immensely concentrated, which actually is essential for only a small proportion of daily activities in this age group. The requirement of slouching and sitting in a comfortable position has been completely neglected and this has resulted in multiple cases of implant failures, resulting in an iatrogenic deformity and requiring the extension of fusion levels, further adding to the morbidity of the patient. A wide range of fusion and non-fusion devices have been developed and promoted including minimally invasive surgery to improvise outcomes. However, we as surgeons have not been able to identify the exact etiopathogenesis and pain generators and this has resulted in a huge number of successful anatomical reconstructive surgeries yet, with persistent pain.

TRAUMA

Surgery in trauma without neural deficits and instability is questionable and yet are being widely performed. Further, the choice of surgical treatments—anterior *vs* posterior, open *vs* minimally invasive, long segment *vs* short segment, fusion *vs* non-fusion procedures, navigated *vs* free hand, and stable *vs* unstable burst fractures continue to be a matter of debate and research in these fields have rather raised more concerns and remain inconclusive. Cervical facet dislocations, translational thoracolumbar injuries, hyperextension injuries, unstable thoracolumbar burst fractures, displaced odontoid fractures pseudoarthrosis and fractures involving neurological deficits are better addressed surgically as they improve the quality of life and reduce the years lost to disability.

DEFORMITY

A reasonable consensus has been achieved amongst the global community that early onset scoliosis (EOS) needs to be addressed to avoid irreversible cardiopulmonary compromise and also in severe progressive deformities, which are usually secondary to congenital, neurofibromatosis, neuromuscular and other syndromes associated deformities. On the other hand, there has been a raging controversy amongst surgeons in determining the threshold for deformity correction in adolescent idiopathic scoliosis (AIS). The risk–benefit ratio of surgical intervention in AIS is considered on the known facts that curves of 30 to 50-degree progress an average of 10 to 15 degrees over a lifetime,> 50 at maturity progress steadily at a rate of 1 degree per year, <30 at bone maturity are unlikely to progress. At 90 degrees or greater, there is increased potential for effects on cardiopulmonary function and therefore need to be prevented. Ultimately, surgical correction for AIS is a procedure to improve the quality of life and should be decided upon by the patient and the family after a proper and the appropriate conversation has occurred regarding the natural progression of the diagnosis, risks of the surgery and alternatives based on the present data available.

TUMOURS

While benign tumours are being increasingly attended to by surgical methods when there is incapacitating pain and deformity due to the availability of minimally invasive procedures, malignant tumours are addressed mainly to improve survival rates and quality of life and often as palliative measures in case of metastasis. Risk stratification in metastasis is done nowadays using Tomita scoring[6] or revised Tokuhashi scoring[7] in order to determine the extent of invasiveness of the planned surgical procedure.

INFECTION

Despite the fact that there are only selective indications for surgery in infection, which include incapacitating pain, deformity, neurological deterioration, extensive vertebral destruction leading to collapse and instability, currently, most of the spinal infections are being operated owing to the inability of the patient population to accept a long symptomatic period and most patients prefer early return to function. Surgical debridement enables early recovery, stabilization promotes healing, and decompression ensures neurological recovery, whilst reconstruction procedures assure good spinal alignment. Most importantly the ability to procure adequate tissue for histopathological and microbial studies put surgical intervention a step forward towards determining the appropriate antibiotic which still remains the cornerstone of treatment in spinal infections. Therefore, surgical interventions are preferred nowadays and the concept of biofilms do not deter instrumentation due to the advancements in titanium implants.

CONCLUSION

Global increase in health care utilization and rise in costs, demands focus oncost-effective therapeutic options based on evidence in spine surgery to have a sustainable health care delivery system. All spine surgeries have their own inherent risks even in well-trained hands and it is evident that surgery based on sound indications offers a cost-effective treatment with good outcomes. This necessitates the surgeon to choose the appropriate surgical indication which however continues to be the most daunting task. Future research should be focused on prevention rather than treatment of spinal disorders.

REFERENCES

1. Sivasubramaniam V, Patel HC, Ozdemir BA, Papadopoulos MC. Trends in hospital admissions and surgical procedures for degenerative lumbar spine disease in England: a 15-year time-series study. BMJ open. 2015 Dec;5(12):e009011.
2. Mannion AF, Impellizzeri FM, Leunig M, Jeszenszy D, Becker HJ, Haschtmann D, Preiss S, Fekete TF. EUROSPINE 2017 FULL PAPER AWARD: Time to remove our rose-tinted spectacles: a candid appraisal of the relative success of surgery in over 4500 patients with degenerative disorders of the lumbar spine, hip or knee. Eur Spine J 2018 Apr: 27(4):778–788.
3. Buchbinder R, van Tulder M, Öberg B, Costa LM, Woolf A, Schoene M, Croft P, Lancet Low Back Pain Series Working Group. Low back pain: a call for action. Lancet 2018 Jun; 391(10137):2384–2388.
4. Volinn E, Mayer J, et al. Small Area Analysis of Surgery for Low-Back Pain. Spine 1992;17(5):575–581.
5. Asghar FA, Hilibrand AS. The impact of the Spine Patient Outcomes Research Trial (SPORT) results on orthopaedic practice. J Am Acad Orthop Surg 2012 Mar; 20(3):160–166.
6. Tomita K, Kawahara N, Kobayashi T, Yoshida A, Murakami H, Akamaru T. Surgical strategy for spinal metastases. Spine (Phila Pa 1976). 2001;26(3):298–306.
7. Tokuhashi, Y, Matsuzaki H, Oda H, Oshima M, Ryu J. A revised scoring system for preoperative evaluation of metastatic spine tumor prognosis. Spine (Phila Pa 1976). 2005; 30(19):2186–2191.

Minimally Invasive Spinal Surgeries

Satishchandra Ramakant Gore
Minimally Invasive Spine Surgeon
MISSILE SPINE, 1128 Shivajinagar, FC ROAD, Model colony,
Dnyaneshwar Paduka Chowk, Pune 16, India

Currently, a shift in the paradigm of spine surgery has resulted in major surgeries being carried out under local anesthesia, with the patient absolutely awake and conscious throughout the surgery. Diagnosis of back pain and sciatica especially in relation to the degenerative spine is complex. It is important to have a patient diagnostic integrated approach to answer fundamental questions regarding origin of pain in the back and leg, confirmation of symptom generator, monitoring pain, indications–contraindications for surgery especially with degenerative lumbar spine and precise targeting of symptom generators.

Aging and degenerated spine are characterized by structural failure which becomes symptomatic. Symptoms are produced due to structural failure in the form of annular tears in the disc, where the barrier between neurological tissue and nucleus pulposus breaks down and induces inflammation. Symptom matrices indicate 6 common presentations in degenerative lumbar spine.

- The commonest cause of knee and heel pain is an annular tear and early chemical radiculitis of L5/S1 nerves.
- Low back pain may originate from a chronic non-healing central posterior annular tear with or without trapped subligamentous fragments.
- Sciatica pain may be due to annular tears with a herniated posterolateral nuclear fragment with mechanical and or chemical radiculitis.
- Facetogenic back pain which is paraspinal, well localized and increases on rotation and extension may be due to facet degeneration and inflammation.
- Hypertrophied tissue around the superior articular process in the foramen and chronic annular changes in upper foramen with or without collapse of the disc may lead to claudication.
- Claudication may originate due to an unstable spine. In case of instability and stable spine with claudication, surgical decisions are guided by images.

Pain is usually due to inflammation or end result of the inflammation process. There cannot be pain in the human body unless there is inflammation. In our experience, 50 % spine pain originates from the disc, 15% from the facet, 30% from herniation and 5% people from other causes. Often young people reporting back pain and difficulty in function have normal discs as observed on MRI. These people are advocated inadequate care by clinicians.

An algorithm for back pain has been developed where Mackenzie test of spinal extension is used to establish treatment strategies. Centralization of pain while performing Mackenzie test

indicates a conservative management strategy, while no centralization, would indicate the need for a discogram to identify the disc protrusion or a broken fragment which can be treated accordingly.

Pain on the lateral aspect of the back increases with extension or rotation and is well localized to multiple spots, then it is generally related to facets. Initially, the treatment is conservative and if necessary facetal interventions can be performed. The Mackenzie test is used as a primary mean of screening. It confirms annular integrity with *in vivo* endoscopic visualisation of pathoanatomy.

For short facet denervation, a line is drawn across sides of the pedicle and a needle is inserted along the upper border of the transverse process. Endoscopically, if the medial branch of the dorsal ramus, which is involved in the pain generation, is seen, the nerve may be cut or laser may be used. Immediate increase in extension and pain relief lasting for about a year or more is reported by patients. However, sympathetic fibers regenerate and pain may recur which may need further surgery or further treatment.

Leg pain and pain along lateral aspect of the knee is a common manifestation of L5 while heel pain is a common manifestation of S1 radiculopathy. If the pain centralizes on Mackenzie's test and a distal block helps, medical treatment with an intradiscal injection or periradicular injection is preferred. In cases where pain does not centralize, distal blocks are ineffective, SLR is positive and there is neurological involvement, then an MRI is used to correlate pathology with symptoms. Annular tears are cleaned and fragments are excised. In cases where there are no fragments, medical treatment is preferred. Foraminoplasty is done in case of stenosis. In case of instability, fixation may be required. MRI may lack correlation in about 30% cases. Three points of importance in MRI images are—low signal intensity, high intensity and endplate changes in T2 weighted images or commonly on a T1 weighted image.

Knee pain which increases while sitting on the floor with a cross leg for more than 5 minutes or 10 minutes indicates loss of stretchability of the sciatic nerve. The pain is generally anteroposterior or on the lateral aspect. Heel pain often originates from a tender S1. Leg pain can be relieved by local anaesthetic, which is a sodium channel blocker in the sural nerve or deep peroneal nerve.

Indications for Non-surgical Management

In degenerative spine, when pain centralizes on extension and when there is a chemical cause of inflammation detected by the tender nerve, which respond to a block, no surgical intervention is indicated.

Indications for Surgical Management

Soft nuclear herniation is resolved within two months time with anti-inflammatory or steroids and may be treated conservatively. In cases where the annulus is collagenized and hardened and a fragment from the end plate is fracture, surgical intervention may be indicated. Progressive neurological deficit is definitely a red flag and requires early intervention.

Microdiscectomy targeting disc herniations are practiced widely. The surgery has evolved from discectomy and laminectomy to more of the same decompression stabilization for all stages of the degenerative spine. Lumbar canal stenosis requires removal of ossification-calcification of the posterior annulus, osteophyts that compress nerve root, scrapping off excessive bone and removal of inter-laminar portion of ligamentum flavum. Transiliac surgery can be performed in women with a deep pelvis.

In conclusion, detect, confirm, and monitor the cause of sciatic pain. Secondly, target the pain generators in the back and leg. Stitchless surgery for back pain, sciatica and claudication are possible. Move away from the images, as they may not present a real picture. A good clinical diagnosis may help identify the cause, empathize with the patient and understand the suffering. It would enable us to offer a better solution to our patients.

SYMPOSIUM VII

Models of Spine Care

The Global Spine Care Initiative (GSCI): An Evidence-based Model of Care that can be Widely Implemented to Reduce the Burden of Spinal Disorders

Keynote Address

Scott Haldeman
President, World Spine Care
801 N Tustin Ave # 202, Santa Ana
CA 92705, USA

The Global Spine Care Initiative (GSCI) was created by World Spine Care (WSC) to reduce the global burden of disease and disability by bringing together leading health care providers, scientists, specialists, government agencies, and other stakeholders to transform the delivery of spine care. It is a 4-year initiative by 68 clinicians from 24 countries.The majority of participants (58) had clinical experience providing care in 36 countries across 6 continents. 31 had some level of clinical experience in low- and middle-income countries (LMICs). This interdisciplinary team included 26 medical specialists and surgeons, 11 chiropractors, 10 university and higher education teachers, 6 epidemiologist, 4 administrative professionals, 3 physical therapists, as well as representatives from psychology, legal, nursing, statistics, anthropology, library and general medical professions.

Participants Who Contributed to the GSCI

Margareta Nordin, Roger Chou, Pierre Côté, Eric L. Hurwitz, Claire D. Johnson, Kristi Randhawa, Bart N. Green, Deborah Kopansky-Giles, Emre Acaroðlu, Arthur Ameis, Christine Cedraschi, Ellen Aartun, Afua Adjei-Kwayisi, Selim Ayhan, Amer Aziz, Teresa Bas, Fiona Blyth, David Borenstein, O'Dane Brady, Peter Brooks, Connie Camilleri, Juan M. Castellote, Michael B. Clay, Fereydoun Davatchi, Jean Dudler, Robert Dunn, Stefan Eberspaecher, Juan Emmerich, Jean Pierre Farcy, Norman Fisher-Jeffes, Christine Goertz, Michael Grevitt, Erin A. Griffith, Najia Hajjaj-Hassouni, Jan Hartvigsen, Maria Hondras, Edward J. Kane, Julie Laplante, Nadège Lemeunier, John Mayer, Silvano Mior, Tiro Mmopelwa, Michael Modic, Jean Moss, Rajani Mullerpatan, Elijah Muteti, Lillian Mwaniki, Madeleine Ngandeu-Singwe, Geoff Outerbridge, Shanmuganathan Rajasekaran, Heather Shearer, Matthew Smuck, Erkin Sönmez, Patricia Tavares, Anne Taylor-Vaisey, Carlos Torres, Paola Torres, Alexander van der Horst, Leslie Verville, Emiliano Vialle, Gomatam Vijay Kumar, Adriaan Vlok, William Watters III, Chung Chek Wong, Jessica J. Wong, Hainan Yu, Selcen Yüksel.

Affiliations, biases and conflicts of interest are addressed in a specific GSCI article by Claire D. Johnson, Scott Haldeman, Margareta Nordin, Roger Chou, Pierre Côté, Eric L. Hurwitz, et al. **The Global Spine Care Initiative: methodology, contributors, and disclosures.** *European Spine Journal*. September 2018, Volume 27, Supplement 6, pp 786–795.

Funding for this Initiative was by grants from the Skoll Foundation, the NCMIC Foundation and the European Spine Journal.

Introduction and Background

According to the World Report on Disability 2011 published by the WHO and World Bank more than a billion people in the world today experience disability. Disability disproportionately impacts: Women, the elderly, rural communities, the lowest income quintile of the population and lower income countries. Arthritis, rheumatism and back problems were the most common health conditions related to disability. According to the Global Burden of Disease studies, back and neck pain combined have a greater impact on global health (DALYs) than HIV/AIDs, Alzheimer's disease, malaria, diabetes, lower respiratory infections, depression, stroke, traffic injuries, or breast and lung cancer combined.

Attempts to reduce the burden of disability in high income countries have resulted in a proliferation of treatment approaches. There are over 200 treatments currently being offered by clinicians, most of which have limited or no evidence of effectiveness. There has also been a marked increase in health expenditures over the past 2 decades in an attempt to address this problem. This has resulted in exponential increase in such treatment approaches as opioids despite the fact that randomized clinical trials have shown no significant difference on pain-related function over 12 months between opioid and non-opioid medications. Pain intensity is significantly better in the nonopioid group and adverse medication-related symptoms are significantly more common in the opioid group. Similarly, there has been a marked increase in surgical interventions including fusion for the management of chronic axial low back pain. However, the results of a number of studies that have shown that disability, VAS back pain, work status, pain medication, and pain frequency are not significantly different in those undergoing surgery and those being managed with non-surgical care. These studies also note that adverse events and costs are considerably higher in patients with chronic low back pain undergoing fusion surgery compared to non-surgical care. Recent studies have noted that health care expenditure in the United States for low back and neck pain is $87.6 billion. Despite this expenditure, disability rates related to spinal pain appears to be increasing.

The challenge faced by the GSCI therefore was to develop a model of care that addresses the problem of spine related disorders and associated disability in underserved communities and LMICs without reproducing the policies and priorities that have dominated spine care in high income countries. To add to the challenge, recent reviews noted that, for 50% of the global population, primary care general physicians spend 5 min or less with their patients and the majority of patients who do seek care for spine related complaints in LMICs are managed in emergency rooms or are admitted to hospital which is the most expensive and least effective means of managing spine related symptoms and disability.

Methodology

The GSCI conducted 8 literature reviews with the goal of determining the extent of the burden of disease and which interventions could reasonably be considered in an evidence-based Model of Care. Two reviews were on the burden of disease; globally and in low income communities. Six reviews of spine related interventions were in the following broad categories: *Assessment, non-invasive management of spine pain, invasive management of spinal disorders, psychosocial management of spine pain, public health and preventive interventions, interventions for serious red flags spine pathologies (osteoporosis was used as an example of systemic disease affective the spine):*

This was followed by a modified Delphi consensus. The final draft of the Model of Care articles was agreed upon by all coauthors after 5 face-to face meetings of the core members of the GSCI and 3 consensus rounds of all GSCI participants.

The goal of the GSCI Model of Care was to ensure that *the "Right Care was given to the Right Person at the Right Place and at the Right Time".*

The GSCI Model of Care

The development of a care pathway required that people with spine-related symptoms, concerns or disability be differentiated in a manner that would allow the linkage of the patient presentation to the interventions identified in the literature reviews as having reasonable evidence of appropriateness and benefit. After review of the literature it became evident that current classification systems were not suitable. Using the most commonly used systems that differentiate people with spinal disorders as templates and an intensive consensus debate, the following classification system was recommended by the GSCI.

The GSCI Classification: (abstracted from reference 12)

Class 0: General population, no or minimal spine related symptoms[a], no interference with activities, no neurological deficits, no severe pathology

- Class 0a: No or minimal occasional discomfort, no evident risk factors for a spine related disorder or pain, potential for primary prevention[b]
- Class 0b: No or minimal occasional discomfort, one or more risk factors for a spine related disorder or pain, potential for primary prevention[b]

Class I: Spine related symptoms[a], no or minimal interference with activities, no neurological deficits, no severe pathology

- Class Ia: Acute or subacute[c] mild pain with no or minimal interference with activities of daily living[d]
- Class Ib: Chronic or recurrent[e] mild pain with no or minimal interference with activities of daily living[d]

Class II: Spine related symptoms[a], interference with activities, no neurological deficits, no severe pathology

- Class IIa: Acute or subacute[c] moderate pain with interference with activities of daily living[f]
- Class IIb: Chronic or recurrent [e] moderate pain with interference with activities of daily living[f]
- Class IIc: Acute or subacute[c] severe pain with interference with activities of daily living[g]
- Class IId: Chronic or recurrent[e] severe pain with interference with activities of daily living[g]

Class III: Spine related symptoms[a] with neurological symptoms or deficits, interference with activities, focal pathology compromising neural structures

- Class IIIa (acute/mild): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Likely to require immediate intervention
- Class IIIb (acute/progressive): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Likely to require immediate (possibly emergency) intervention
- Class IIIc (chronic[e]/stable[h]): (e.g., radiculopathy, myelopathy, cauda equina syndrome). Unlikely to require immediate (emergency) intervention

Class IV: Spine related symptoms with severe deformity[a], with or without interference with activities, with or without neurological deficits

- Class IVa: Stable,[h] chronic[e] spine pathology without correlation with symptoms (e.g. low grade or stable spondylolisthesis, spinal deformities, scoliosis, spinal stenosis, stable healed fractures and congenital disorders)
- Class IVb: Stable,[h] acute or chronic[e] spine pathology with correlation to symptoms (e.g. symptomatic high grade and unstable spondylolisthesis, spinal deformities, scoliosis, spinal stenosis, fractures and congenital disorders)

Class V: Spine related symptoms[a] with severe or systemic pathology, interference with activities, with or without neurological deficits

- Class Va: Severe acute spinal pathology likely to require immediate (emergency) intervention. (e.g. unstable fractures, acute infections)
- Class Vb: Severe, slowly progressive spinal pathology. Requires intervention but not an emergency (e.g. inflammatory joint diseases, osteoporosis with stable compression fractures, destructive pathology such as neoplasms or chronic infections)
- Class Vc: Spine symptoms originating from non-spine pathology that require intervention (e.g. referred angina, genitourinary tract infections, cerebrovascular dissections)

Legend for the GSCI Spinal Disorders Classification

a. Symptoms = spine related symptoms: (e.g. pain, psychological symptoms, psychosocial stress, altered sensation, weakness, incoordination, incontinence, breathing difficulties, etc.)

b. Prevention = public and population health intervention measures to reduce or prevent injury and spinal disorders. These may include occupational injury prevention, social policy (e.g. no-fault insurance), prenatal care (e.g. nutrition to prevent spina bifida), osteoporosis screening, exercise programs, etc.

c. Acute or subacute = as defined by the evidence for a specific intervention, usually ≤3 months

d. Mild pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores[16] "mild" (score 8–27) pain (i.e. 8 = least impact to 50 = greatest impact)

e. Chronic or recurrent = as defined by the evidence for a specific intervention, usually >3 months

f. Moderate pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores[16] "moderate" (score 28–34) pain (i.e. 8 = least impact to 50 = greatest impact)

g. Severe pain = National Institutes of Health (NIH) Pain Consortium Impact Classification Scores[16] "severe" (score ≥35) pain (i.e. 8 = least impact to 50 = greatest impact)

h. Stable = unchanging and unlikely to change in the short term but may require symptomatic care

i. Progressive = increasing symptoms, pathology or deficits

The GSCI Care Pathway (abstracted from reference 13)

The care pathway consisted of 5 steps that a clinician can easily learn and follow irrespective of professional training and experience.

Step 1: Awareness: ìI have a spine problem. Is it serious?î

Any person who becomes aware of and has a concern about a spine problem is expected to seek information on what they can and should do. This requires access to educational materials and public health messages. These messages should include: Evidence-based information, the risks associated with spine-related disability and symptoms as well as the natural history of spine symptoms and prognostic factors, activities that a person can consider for the prevention of disability, self-assessment, and self-management.

The success of step 1 is dependent on easy access to information. The ideal method of ensuring that this step will benefit the person who becomes aware of and help him or her decide what to do is a public health program and regular community-based education via all possible vehicles including print, visual and digital media.

Step 2. Initial Triage: ìDo I need to see a spine care clinician?î

This is highly dependent on whether the public health and community-based education program has provided the information necessary for a person to make the correct decision. Many patients

with spine symptoms may feel they need to seek advice from a clinician who is aware of and trained in providing research validated information to people with spine problems who are seeking advice. This requires a consistent, accurate and easily understood message that informs the person with a spine related complaint that allows them to make the following decisions:

"Can I consider self-care?" "If so, what should I do?" "Do I need to see a spine care clinician"

Step 3. Provider assessment: ìHow should I assess the patientís clinical condition?î

"Should I order tests and if yes what tests should I order?"

This step becomes necessary if a person's self-triage reveals that he or she requires further care, if the patient does not have access to a public health message or is still unsure of what to do and is seeking care. The following assessment interventions should be considered.

1. A detailed history
2. Assessment tools to measure pain severity, disability and impairment.
3. Psychological and social flags to identify psychosocial risk factors for disability.
4. Red flags to identify possible serious spine pathology.
5. Spinal, neurological and general physical examination.
6. Appropriate diagnostic imaging or laboratory testing should only be considered when indicated by the history and examination and should not be considered routine or necessary for the majority of people with spine related symptoms, especially spine pain without red flags.

The assessment should allow the clinician to assign the spine-related concern to a specific class and subclass. To assist in this process the GSCI is developing flashcards and wall charts that can be used in any clinical setting.

Step 4: Intervention: ìWhich treatment intervention should I offer the patientî

Once a patient has been assigned to one of the GSCI diagnostic classes and subclasses, the clinician is able to offer one or more of the treatment interventions determined by the GSCI as having sufficient evidence to warrant consideration. The recommendations vary depending on the GSCI class and subclass. The GSCI is developing flashcards and wall charts that can guide the clinician in the treatment of patients.

The final decision on the GSCI recommendations are then presented to the patient with a shared decision on which treatment options the patient should consider. The following principles should be discussed with the patient to ensure that the patient has full understanding and expectations from the treatment.

- Only evidence-based interventions as presented by the latest GSCI findings should be offered. The discussion should include the following information for each available treatment option.
  - Benefits
  - Harms
  - Costs
  - Alternatives
  - Availability within the clinical setting
  - Patient preference
- Following a shared decision agreed upon by the patient/family and the clinician/interdisciplinary team the intervention is initiated.

Step 5: Outcomes

In most cases, there are 3 possible outcomes:

1. Positive response to the treatment intervention
   - The patient has no further symptoms, all questions have been answered, no further care is felt to be necessary.
   - The patient is discharged
2. Positive response to the treatment intervention but residual symptoms or concerns persist
   - The clinician should reassess the patient to determine if she or he should be assigned to the same class or whether their presentation is more consistent with another class and/or subclass.
   - The clinician should then review the GSCI intervention list for the patient's new class and subclass and consider an alternative intervention from this list.
3. No or negative response to the treatment intervention.
   - The clinicians should reassess the patient to determine if same or another class or subclass needs to be assigned.
   - The clinician then could apply another treatment recommended in the GSCI treatment options for that class or consider referral to a different level of care that may include imaging or testing and subspecialty consultation.

The Resources necessary to Implement the GSCI Care Pathway (abstracted from reference 14)

The implementation of an evidence-based model of care as recommended by the GSCI requires first and foremost clinicians who are trained and knowledgeable in the current evidence on the management of all spine related disorders. By far the vast majority with a spine-related problem can be managed in a community based or outpatient clinical setting. A small number of these require imaging and other advance diagnostic testing. Very few people with spine related symptoms require advanced medical or surgical specialists, emergency room care or admission to hospital.

In order to achieve the triage of patients and management of each individual in the most cost-effective manner the GSCI recommends that there be four levels of spine care that are closely integrated so that each patient receives the care that is most appropriate for their presentation. Each of these settings would be responsible for the management of specific classes and subclasses of spinal disorder.

Level 1ó Community based and Self-care

The GSCI articles on non-invasive care, public health and psychosocial interventions recommend an emphasis on self-care and community-based care. This may be achieved through education to avoid misunderstanding of the prognosis and catastrophizing of spine pain. It is probable that any community-based and self-care management of spinal disorders would fall on the shoulders of the primary spine care providers unless it is possible to persuade government agencies to consider an education program within their public health resource budget.

Level 2ó Primary Spine Care

In the GSCI model of care, primary spine care is delivered by health care providers with training and skills in evidence-based spine care. The necessary skills of a primary spine care clinician include the initial assessment of patients, triage for red flags suggestive of serious pathology, documentation of psychological or social yellow flags and the management of patients with non-specific pain and related disability (Class I and II). The latter would include patient and community education and non-invasive, low technology, low cost interventions for symptom relief. Primary spine care providers would be responsible for referral and coordinating care for complex spinal disorders that may require secondary and tertiary spine care interventions (Class III, IV and V). It is expected that primary spine care clinicians would provide community-based information and encourage self-care when that is the most appropriate care (Class 0, I).

Secondary Spine Care

Secondary care is often provided at the district hospital level and includes emergency and trauma care, basic diagnostic imaging and laboratory testing, inpatient, and surgical facilities. Secondary care is considerably more expensive and resource intensive than primary care. Providers at the secondary spine care level tend to have specialist training but not subspecialty training. Secondary spine care services typically include short-term interventions that require one or more of the following: Acute trauma and emergency care, hospitalization, consultation, injections and rehabilitation. Ideally the resources to provide psychological and social interventions as well as some level of pharmaceutical and spine surgery care would exist in this setting.

Tertiary and Quaternary Spine Care

Tertiary spine care is specialized medical and surgical care for complex, serious and unusual spinal disorders that cannot be managed at the primary or secondary spine care levels. This level of care requires the highest level of resources and is commonly carried out in large inpatient hospitals. Care is provided primarily by clinicians with subspecialty training in such fields as rheumatology, neurology, infectious disease, oncology, and most internal medicine subspecialties as recommended in the GSCI Care Pathway for Class V diseases. The tertiary spine care setting would also require surgeons with advanced spine surgical skills and the supporting surgical infrastructure and personnel to manage the most complex surgical procedures that may be necessary to address severe spine trauma and deformity (Class IVb) and destructive spine pathology (Class V). Typically, tertiary care facilities have advanced diagnostic equipment, and intensive care units.

GSCI take Home messages (from reference 1)

1. A large, international, and interdisciplinary team of 68 clinicians and scientists from 24 countries developed an evidence-based implementable model of care for the management of spinal disorders in underserved communities and low- and middle-income countries.
2. The proposed model has four levels of care: Community-based self-care programs, primary spine care, secondary spine care, and tertiary spine care. This model of care has the capacity to address all patients likely to present to a health care setting for a spine-related symptom or concern.
3. Ensuring that the right patient receives the right intervention at the right time and in the right setting and that excessive and unnecessary high-cost care is avoided, may be best achieved by matching care settings to the patient presentation, available resources, and clinician skills and expertise.
4. The GSCI proposes an evidence-based model that is consistent with recent calls for action to reduce the global burden of spinal disorders. The model requires testing to determine feasibility. If it proves to be implementable, this model holds great promise to reduce the tremendous global burden of spinal disorders.

BIBLIOGRAPHY

References for statements in this review are available on request.

The articles detailing the results of the Global Spine Care Initiative are included in a special supplement of the European Spine Journal. Volume 27, Supplement 6, September 2018.

1. Haldeman S, Nordin M, Chou R, Côté P, Hurwitz EL, Johnson CD, Randhawa K et al. The Global Spine Care Initiative: World Spine Care executive summary on reducing spine-related disability in low- and middle-income communities. Eur Spine J 2018 Sep; 27(Suppl 6):776–785.
2. Johnson, CD, Haldeman S, Nordin M, Chou R, Côté P, Hurwitz EL, et al (2018) The Global Spine Care Initiative: metthodology, contributors, and disclosures. Eur Spine J 2018 Sep;27(Suppl 6):786–795.

3. Hurwitz EL, Randhawa K, Yu H, Côté P, Haldeman S. The Global Spine Care Initiative: a summary of the global burden of low back and neck pain studies. Eur Spine J 2017 2018 Sep;27(Suppl 6):796–801.
4. Hurwitz EL, Randhawa K, Torres P, Yu H, Verville L, Hartvigsen J, Côté P, Haldeman S. The Global Spine Care Initiative: a systematic review of individual and community-based burden of spinal disorders in rural populations in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):802–815.
5. Green BN, Johnson CD, Haldeman S, Kane EJ, Clay MB, Griffith EA, Castellote JM, Smuck M, Rajasekaran S, Hurwitz EL, Nordin M, Randhawa K, Yu H. The Global Spine Care Initiative: public health and prevention interventions for common spine disorders in low- and middle-income communities. Eur Spine J 2018 Sep;27 (Suppl 6):838–850.
6. Nordin M, Randhawa K, Torres P, Yu H, Haldeman S, Brady O, Côté P, Torres C, Modic M, Mullerpatan R, Cedraschi C, Chou R, Acaroðlu E, Hurwitz EL, Lemeunier N, Dudler J, Taylor-Vaisey A, Sönmez E. The Global Spine Care Initiative: a systematic review for the assessment of spine-related complaints in populations with limited resources and in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):816–827.
7. Chou R, Côté P, Randhawa K, Torres P, Yu H, Nordin M, Hurwitz EL, Haldeman S, Cedraschi C. (2017) The Global Spine Care Initiative: applying evidence-based guidelines on the non-invasive management of back and neck pain to low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):851–860.
8. Cedraschi C, Nordin M, Haldeman S, Randhawa K, Kopansky-Giles D, Johnson CD, Chou R, Hurwitz EL, Côté P. The Global Spine Care Initiative: a narrative review of psychological and social issues in back pain in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):828–837.
9. Acaroðlu E, Mmopelwa T, Yüksel S, Ayhan S, Nordin M, Randhawa K, Haldeman S. The Global Spine Care Initiative: a consensus process to develop and validate a stratification scheme for surgical care of spinal disorders as a guide for improved resource utilization in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):879–888.
10. Ameis A, Randhawa K, Yu H, Côté P, Haldeman S, Chou R, Hurwitz EL, Nordin M, Wong JJ, Shearer HM, Taylor-Vaisey A. The Global Spine Care Initiative: a review of reviews and recommendations for the non-invasive management of acute osteoporotic vertebral compression fracture pain in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):861–869.
11. Acaroðlu E, Nordin M, Randhawa K, Chou R, Côté P, Mmopelwa T, Haldeman S. The Global Spine Care Initiative: a summary of guidelines on invasive interventions for the management of persistent and disabling spinal pain in low- and middle-income communities. Eur Spine J 2018 Sep;27(Suppl 6):870–878.
12. Haldeman S, Johnson CD, Chou R, Nordin M, Côté P, Hurwitz EL, Green N, Kopansky-Giles D, Cedraschi C, Aartun E, Acaroðlu E, Ameis A, Ayhan S, Blyth F, Borenstein D, Brady O, Davatchi F, Goertz C, Hajjaj-Hassouni N, Hartvigsen J, Hondras M, Lemeunier N, Mayer J, Mior S, Mmopelwa T, Modic M, Mullerpatan R, Mwaniki L, Ngandeu-Singwe M, Outerbridge G, Randhawa K, Sönmez E, Torres C, Torres P, Watters W 3rd, Yu H. The Global Spine Care Initiative: classification system for spine-related concerns. Eur Spine J 2018 Sep;27(Suppl 6):889–900.
13. Haldeman S, Johnson CD, Chou R, Nordin M, Côté P, Hurwitz EL Green BN, Cedraschi C, Acaroðlu E, Kopansky-Giles D, Ameis A, Adjei-Kwayisi A, Ayhan S, Blyth F, Borenstein D, Brady O, Brooks P, Camilleri C, Castellote JM, Clay MB, Davatchi F, Dunn R, Goertz C, Griffith EA, Hondras M, Kane EJ, Lemeunier N, Mayer J, Mmopelwa T, Modic M, Moss J, Mullerpatan R, Muteti E, Mwaniki L, Ngandeu-Singwe M, Outerbridge G, Randhawa K, Shearer H, Sönmez E, Torres C, Torres P, Verville L, Vlok A, Watters W 3rd, Wong CC, Yu H. The Global Spine Care Initiative: care pathway for people with spine-related concerns. Eur Spine J 2018 Sep;27(Suppl 6):901–914.
14. Kopansky-Giles D, Johnson CD, Haldeman S, Chou R, Côté P, Green BN, Nordin M, Acaroðlu E, Ameis A, Cedraschi C, Hurwitz EL, Ayhan S, Borenstein D, Brady O'D, Brooks P, Davatchi F, Dunn R, Goertz C , Hassouni NH, Hartvigsen J, Hondras M, Lemeunier N, Mayer J, Mior S, Moss J, Mullerpatan R, Muteti E, Mwaniki L, NgandeuSingwe M, Outerbridge G, Randhawa K, Torres C, Torres P, Vlok A, Wong CC. The Global Spine Care Initiative: resources to implement a spine care program Eur Spine J 2018 Sep;27(Suppl 6):915–924.
15. Johnson CD, Haldeman S, Chou R, Nordin M, Green BN, Côté P, Hurwitz EL, Kopansky-Giles D, Acaroðlu E, Cedraschi C, Ameis A, Randhawa K, Aartun E, Adjei-Kwayisi A, Ayhan S, Aziz A, Bas T, Blyth F, Borenstein D, Brady O, Brooks P, Camilleri C, Castellote JM, Clay MB, Davatchi F, Dudler J, Dunn R, Eberspaecher S, Emmerich J, Farcy JP, Fisher-Jeffes N, Goertz C, Grevitt M, Griffith EA, Hajjaj-Hassouni N, Hartvigsen J, Hondras M, Kane EJ, Laplante J, Lemeunier N, Mayer J, Mior S, Mmopelwa T, Modic M, Moss J, Mullerpatan R, Muteti E, Mwaniki L, Ngandeu-Singwe M, Outerbridge G, Rajasekaran S, Shearer H, Smuck M, Sönmez E, Tavares P, Taylor-Vaisey A, Torres C, Torres P, van der Horst A, Verville L, Vialle E, Kumar GV, Vlok A, Watters W 3rd, Wong CC, Wong JJ, Yu H, Yüksel S. The Global Spine Care Initiative: model of care and implementation Eur Spine J 2018 Sep;27(Suppl 6):925–945.

Integration of Yoga Therapy in Spine Care

Arthur Brownstein
Preventative Medicine Specialist
Department of Medicine
University of Hawaii, USA (ret.)
932 Ward Ave #16, Honolulu
HI 96814, USA

Modern Western Lifestyle has fostered a crippling epidemic of back pain. A fast pace of living along with "information overload" conspire to create increasing stress, which, over time can cause tight, stiff, and weak spine muscles, contributing to poor spine health and setting the stage for injuries. Additionally, computer technology and motorized transport cause increased time while sitting, which further compresses the spinal structures. Chronic pain cases number an estimated 1.5 billion worldwide, the majority of which are caused by spine conditions. Spine pain is disabling and causes more man-hours of lost labor, than any other health condition, adversely affecting economies as well as disrupting families, especially among those already struggling to make ends meet. Treatments are often prolonged and expensive, and opioids pain killers are addicting, additionally destroying lives and families, adding a second complicating problem to the epidemic of spine pain.

Yoga is an ancient system that is primarily preventive in nature in that it teaches self-care. In so doing, it empowers patients to take charge of their own health. In many cases, it has been shown to be curative as well, especially when practiced regularly. Recent studies are demonstrating yoga's therapeutic efficacy in the area of spine care.

Yoga approaches spine care from a dual perspective involving both mind and body. By calming and relaxing the mind through gentle relaxation, meditation, and breathing practices, stress is neutralized and diminished. By calming and relaxing the brain and nervous system, this, in turn, induces relaxation of the spinal musculature. On a physical level, yoga employs gentle stretching practices that directly stretch the muscles, increasing flexibility while decreasing pain of both spinal muscles and adjacent musculature. Through yoga, patients can learn a drug-free, surgery free, inexpensive approach to effectively improve the health of their spines. They can also learn to safely manage their own spine pain in its earliest stages, should it arise, and prevent it from developing into a more serious condition that would require surgery, and/or a more chronic, debilitating condition that could permanently exclude them from gainful employment.

REFERENCES

1. Saper RB, Sherman KJ, Cullum-Dugan D, Davis RB, Phillips RS, Culpepper L. Yoga for chronic low back pain in a predominantly minority population: a pilot randomized controlled trial. *Altern Ther Health Med* 2009 Nov-Dec; 15(6): 18–27.
2. Brownstein A. Healing Back Pain Naturally. Gig Harbor, Washington: Harbor Press; 1999.1–288p.

ANNEXURES

Interviews and Feedback from Speakers and Participants

Dr Scott Haldeman DC, MD, PhD**:** We were extra ordinally pleased to see the success of this meet. We are very proud as a part of world spine care to be part of the changes that are happening here in India, in the health care area, particularly in the spine care area. We are truly pleased with the relationship between MGM and world spine care and look forward to advancing this further. This week was very interesting. All had devoted their time to the meeting. The audience was very attentive, throwing questions throughout the meeting, the interactions had been fabulous and we are hoping to expand the world spine care program within India.

Dr Margerita Nordin, Doctor of Medical Science, Physiotherapy: This has been a true pleasure. It's a fruit of four years of continuous work and its planning started about a year and a half ago and we have had a very successful conference. We had about 250 people and international faculty and had some excellent questions that we can further use in our model that we are creating. So thank you MGM, this has been a true pleasure to collaborate.

Dr Adam Wilke, DC, VP, and WSC Europe: It was a wonderful conference and thank you MGM for pulling us up, putting it on and inviting us. It was great seeing the diversity of ways of which people cope with spinal pain from the mountains of Nepal to Bangladesh. It was just a lovely conference. And to see the diversity in action, to see how surgeons, physiotherapists, and chiropractors are able to cope with this massive problem that we have regarding spinal care. So thank you for organizing this wonderful event.

Dr S Rajasekaran MS, DNB, FRCS(ED), FRCS (LOND), MCH, FACS, PhD, Chairman and Head, Department of Orthopedics and Spine Surgery, Ganga Medical Centre and Hospitals Private Limited, Coimbatore, India: Spinal disorders and low back pain is increasing exponentially not only in the developed world but also in developing countries and conservative care which is treating people without surgery is something that is highly neglected topic worldwide. So we are glad that MGM Group of Surgeons and Physiotherapy center has taken up this challenging task and they brought different faculties over here to discuss this very important topic.

Dr Carol Cancelliere DC, PhD: I think the future is very bright for the spine specialists, i.e. physiotherapists, chiropractors and osteopaths. The key message which I took from this conference was taking the science to where the people are, not where the facilities are. I am inspired that there's so much more we are going to be able to do by working together.

I am **Dr Arthur Brownstein**, I live in the USA, I am in YES Primary Care Physician specializing in preventive medicine and I have also been a student of yoga for the past 40 years. I am representing

the Kaivalyadham Yoga Institute in Lonavala and I spent a year there trained Diploma in Yoga Education and I am a big proponent of yoga and yoga therapy for spine care. Yoga is all about the spine and it is a mind–body approach and a very gentle and preventive form of teaching people how to take care of themselves so it reduces the economic burden on the spine care and so I am very happy to be at this conference of the World Spine Care and to meet all the wonderful people and delegates and to hear the global efforts on comparing spine disability and being with people who understand the huge burden of spine pain, its disabling not only to individuals but to families and to the workforce and labor force of the different countries and I am very happy to be in India and to know that there are many world projects for spine care as well and I hope to participate in those in future. I was very happy to share our yogic perspective from Kaivalyadham and also possibly build a bridge for future collaboration in work and going into the rural interior in helping poor people who cannot afford to get MRIs and fancy spine surgeries and that we can help solve their spine problems before they get out of hand. So it has been a wonderful experience.

Dr Dollilur Rahman, PT, President, Bangladesh Physiotherapy Association, Dhaka, Bangladesh: This is Dr Dollilur Rahaman, President, Bangladesh Physiotherapy Association as a President of Physical Therapy. This conference was amazing, the organization was very good, gained a lot of latest information, and many surgeons are there who also conclude surgery is not the only solution. One thing from a few surgeons is very interesting when they are calm in the family members they are very strict but regarding the patient, they say surgery is needed which is very sad and should not happen. I am very happy to attend this conference. See you next time, thank you.

Dr KS Gurung, MPT, Therapy Unit Head, Green Pasture Hospital and Rehabilitation Centre, Nepal: I am from Pokhara, Nepal. Basically, I have been working at the rehabilitation center. I got an invitation from Dr. Rajani Ma'am, so I came to attend the workshop, it was very wonderful. We have been treating spine cases in Nepal, it was a huge problem not only spine disorders but also a lot of people had other problem those who were unable to reach our center and were out of the crease in the mountain area. So what I feel now is during this conference we are not alone, we can hope to take world spine care the team as well as MGM they can support us and hope to get a better future. We will see a changed Nepal.

I am **Nadine Harrison** and I am from the European Board of World Spine Care and I have been here in India in Navi Mumbai with my colleagues at the MGM University for attending the conference and it has been an excellent event, very eye-opening, we had whole range of international speakers and it has been very surprising to hear all the difficulties that the clinicians are facing in India, Nepal, and Bangladesh. We had some very eye-opening cases and it has really been a fantastic event, very international and very eye-opening that is my word to describe it. I work as a Chief Rehab Consultant with Dr Shekhar Bhojraj in Spine Foundation. It was very good to be here. One main thing about the conference was that I was very happy to know the importance given to the conservative management in the conference and this will create a very big awareness in our field and I would in fact like everybody to practice the same classification systems and very happy to know the importance of conservative management given globally. We should implement the same in our systems.

Hi this is **Dr Deepak Kumar** from Capri Institute of Manual Therapy and it is a pleasure attending this world spine care conference organized by MGM College of Physiotherapy, Navi Mumbai. The unique thing about this conference is that it's an amalgamation of various professionals like physiotherapist, clinical psychologist, social worker, chiropractor, orthopedican, spine surgeon and the things to learn in this conference is how different professionals approach patients with different backgrounds, like the way you treat a CEO of a company, you cannot treat the same way to the daily wage labor. The requirement is very different and obviously the treatment and approach of the patient will be different and this is what the best thing you learn in the conference. Another best thing was the legends of the biomechanics were here and was a pleasure listening to those

legends like Manohar Panjabi and Margareta Nordin. So it is a wonderful conference and I wish more conferences of such magnitude should keep on organizing in a different parts of the country and this will help not only the professionals but also the patients and the mankind. Another good thing is that they were discussing how to treat patients those who cannot come to you like in rural India because they also have the equal right to stay healthy. So different ways to approach them, different ways to treat them without infrastructure was discussed and this is another very good thing we saw it here and it is a beautiful conference and we enjoyed it thoroughly. Great hospitality, tasty food, and everything was on time.

I am **Manisha Masant**, a student delegate, so the thing that surprised me the most about the conference was that every talk was so well put that everything just went right through even though I am starting off as a physiotherapist. So the change that has been initiated by World Spine Care is supposed to be taken forward, we are supposed to convert this spark into a beautiful fire of creative destruction. So they have laid out the scenario, the current scenario of the society before us and the kind of steps that we need to take in order to create that change. Also, the one thing that I loved, the one part that I loved was when Dr Abhay said that "We are supposed to go where the problems are, and not where the facilities are." This is the one thing that I loved to go and tell everyone about so that everyone is as inspired as I am because of this conference and I am so glad that I could attend this. Thank you so much.

Hello, my name is **Nidhi Padave**, the 1st year MPT student, delegate of this institute. I want to share my experience with this conference, I will not go into saying that it was nice or it was amazing since we all know it since it is an international conference. I would say a thing which surprised me the most was the world burden of the spine and the awareness of how many patients are involved in the back pain scenario in different countries they talked about Canada, they talked about Nepal, they talked about Bangladesh, also about India and me was so much surprised knowing that so many patients are involved in this and from Monday I definitely want to change something in me which I learned from Dr Pradnya who told us about how we should evaluate and how much time should we necessarily give to a particular patient so that we can improve his/her condition. So this is my take-home message. Thank you.

Myself **Sheetal Swamy**, Assistant Professor at MGM Institute of Physiotherapy, Aurangabad. So it was a wonderful experience and what surprised me in this international conference is that the Biomechanics of Suryanamaskara where it was not basic postures it was different poses in Suryanamaskara and the take-home message from this international conference was that it was an integrated approach. The information we gained was very qualitative. Another take home message which I take from this conference is the speakers who gave us the basic knowledge as well as it went till recent advances which is really very important for research like Dr Abhay Bhang's lecture or we can say the one which was like rural areas, it was like recent advances but was concentrating on rural population. I would define this international conference in one word as integrity.

Hi my name is **Chetali Khadye**, I have completed my Masters in Musculoskeletal Physiotherapy and I am currently working as a physiotherapist at Kokilaben Dhirubai Ambani Hospital. What I would like to say is that after attending this conference the most surprising thing for me was the new implants that were available for patients with scoliosis particularly pediatric scoliosis, where they use magnetic fields as one new type of prosthesis and the second one, was for growing spine something which I did not know was available at all. If I have to describe the whole conference in one word, I would say it was very informative and one thing that I am definitely taking home from this the conference is that treating spinal pain is not just as simple as just treating the symptoms mechanically or say manually as a physiotherapist but a lot of it goes into how efficiently I communicate with my patient and I have learned quiet some points as to how I will better myself in that field today. Thank you.

Hello, I am **Josephine Gonsalves** masters of physiotherapy student from **KLE University**, Belgaum. My experience here after listening to all the eminent speakers was very enriching. It was a very informative conference where a new technique of detailed neurological assessment was shown in cases of spine care. Going back to the OPD will definitely have my way of thinking changed towards spine care assessment and treatment. Also, we got to learn the difficulties and how to manage spinal pain patients from rural areas. Surgical techniques used to treat spinal pain were discussed as well, which gave the conference a holistic approach. Effects of various yoga posture like Suryanamaskar on back pain is also something which we can try for our patients.

Namaskar, I am from Punjab, **Guru Granth Sahib World University**. I feel so glad to be a part of spine care conference and having so many elite dignitaries under one roof. A number of practitioners and experts from all fields even vaguely related to spine care were involved which is a very good effort by MGM college. This conference of two days helped understand policy-making for improving spine care services, new evidence-based assessment, and examination techniques. It was a good initiative by MGM College and World Spine Care, I would like to congratulate both for this successful conference.

Bindesh Patel, Registrar of PP Savani, Surat, Gujarat. When I got to know about this conference I immediately enrolled for it as after getting the brochure I came to know there are so many eminent speakers like Dr. Margerita Nordin, Dr Scott Haldeman will be representing world spine care. I really enjoyed the conference and definitely learned a lot. I would describe the conference in one word as excellent because the speakers were excellent, the execution was excellent, I got to learn about many new topics. I got to learn about the current scenario about the world spine care, what MGM has started a part of WSC in India. After going back to my college, I would definitely try to implement for my students and making them aware of what people have been doing for the betterment of society for spine care.

I am **Maya Kishor**, rehabilitation social worker for Smt. Kamala Raheja rehabilitation center for paraplegics, Vashi. This conference was a really enriching experience regarding awareness spinal problems and the disability due to spinal pain. Prevention is also important as is the treatment for spine care, is one of the take away messages for me. What we learned from this conference is that an integrated approach is needed throughout the world to reduce this disability due to spinal pain. In short, it was an excellent conference.

Feedback was sought from all participants. With respect to knowledge, presentations skills of speakers and insight gained, 77–79% participants, felt that they were excellent/good. Updating of recent advances was rated excellent/good by 75% participants, clarity of audio-visual aids was again rated excellent/good by 76%, venue by 80%, refreshments by 66%, definite interest in pursuing a fellowship in spine care was expressed by 35% and potential interest by 39%. Some people wanted to know if the fellowship could be taken up as distance learning.

Overall the conference was well appreciated with participants looking forward to learning more in preventive and evidence-based knowledge in spine care and wanting to be a part of the World Spine Care team.

PHOTOGRAPHS

World Spine Care team visit to MGM-World Spine Care Clinic, Kamothe, MGM Hospital, Navi Mumbai

Left to right: Adam Wilke, Juhi Bharnuke, Pradnya Girdhar, Carol Cancellier, Rajani Mullerpatan, Margarita Nordin, Scott Haldeman, Alberto Zerbi, Yuvraj Singh

Meeting of World Spine Care Team with MGM Institute of Health Sciences Governing Body

Left to right: Pradnya Girdhar—Assistant Professor, MGMSOP; Carol Cancelliere—WSC Team, Prof Margarita Nordin—President WSC Europe; Prof Scott Haldeman—President WSC; Dr Shashank Dalvi—Vice Chancellor MGMIHS, Dr Adam Wilke—Vice President World Spine Care Europe; Dr SN Kadam Medical Director, MGMIHS; Dr Alberto Zerbi—WSC Team, Dr Rajani Mullerpatan—Director Physiotherapy, MGM School of Physiotherapy, MHMIHS

Visit of spine conference speakers to MGM Center of Human Movement Science

Left to right Photo 1: Prof Margarita Nordin, Dr Alberto Zerbi , Prof Manohar Punjabi

Left to right Photo 2: Sneha, Dr Megha Bandawade (PT), Dr Juhi Bharnuke, Dr Triveni Shetty (PT), Dr Kim, Dr Manohar Punjabi, Dr Rajani Mullerpatan, Rajal, Anuja

International Conference on "Spine Care: Prevention, Early Detection and Management of Spine Disability: A Patient-centric Integrated Approach"

Speakers at MGM-WSC Conference







World Spine Care team visit to Dhamani Village

SCIENTIFIC PROGRAMME

Friday January 18, 2019

Symposium I: Spine Structure and Function

Moderator: *Dr Margareta Nordin*

09.10–09.50	**Keynote:** Spine biomechanics for clinicians	*Dr Manohar Panjabi*
09.55–10.10	Bone health of spine: India and global	*Dr Priyank Patel*
10.15–10.30	Biomechanics of spine in traditional Indian movements	*Dr Rajani Mullerpatan*
10.35–10.50	**Panel discussion**	
10.50–11.10	**Break**	

Symposium II: Evaluation of Spine—Triage of Care

Moderator: *Dr Scott Haldeman*

11.15–11.55	**Keynote:** Primary care triage of spine disorder 'red flags'	*Dr Adam Wilke*
12.00–12.15	Physical spine evaluation	*Pradnya Girdhar*
12.20–12.35	Radiological spine evaluation	*Dr Alberto Zerbi*
12.40–12.55	**Panel discussion**	
13.00–13.40	**Lunch**	

Symposium III: Spine Disability–Various Patient Groups and Different Perceptions

Moderator: *Dr Pierre Côté*

13.45–14.20	**Keynote:** Spine disability caused by trauma, degeneration, infection and auto-immune disorders	*Dr Kuldip Raj Salgotra*
14.25–14.40	WHO disability concept spine disorders	*Dr Carol Cancilliere*
14.45–15.00	Spine disability in Cerebral Palsy	*Dr Ashok Johari*
15.00–15.15	**Panel discussion**	
15.15–15.35	**Break**	

Symposium IV: Burden of Spine Disorders—Global and Indian Scenario

Moderator: *Dr Rajani Mullerpatan*

15.35–16.15	**Keynote:** Global burden of spine disorders	*Dr Pierre Côté*
16.20–16.35	Burden of spine disability in India: Southwest Maharashtra	*Yuvraj Singh & Shweta Nahar*
16.40–17.55	Burden of spine disability in Bangladesh	*Dr Dollilur Rahman*
17.00–17.15	Burden of spine disability in Nepal	*Dr Khadga Gurung*
17.15–17.30	**Panel discussion**	

Saturday January 19, 2019

Symposium V: Conservative Management of Spine

Moderator: *Dr S Rajasekaran*

09.00–09.40	**Keynote:** What is the best early care when is it needed based on evidence?	*Dr Margareta Nordin*
09.45–10.00	The MGM-WSC clinic for underserved population	*Dr Rajani Mullerpartan*
10.05–10.20	The Gadchiroli Healthcare Model	*Dr Abhay Bang*
10.25–10.40	**Panel discussion**	
10.40–11.00	**Break**	

Symposium VII: Models of Spine Care

Moderator: *Dr. Carol Cancellieri*

13.25–14.05	**Keynote:** Global Spine Care Initiative (GSCI) approach	*Dr Scott Haldeman*
14.30–14.45	Role of Yoga in integrated model of spine care Live demonstration in last 5 minutes of session	*Dr Arthur Brownstein, Miss Sindhu Tiwari, Kaivalyadhamteam, Lonavala*
14.10–14.25	Turning evidence into policy of spine care	*Dr Pierre Côté*
14.50–15.05	**Panel discussion**	

Symposium VIII: An integrated approach for prevention of spine disability in urban poor and rural sector and manual labourers Panel discussion (15.10–15.40)

Moderator: *Dr Scott Haldeman*

Contributors: *Dr Margareta Nordin, Dr Raghu Prasad Varma, Dr Rajani Mullerpatan, Dr Pierre Côté, Dr Kuldeep Raj Salgotra, Dr Sadhana Tayade*

15.40–15.55	Break
15.55–16.15	**Valedictory**

SCIENTIFIC PROGRAM COMMITTEE

1. **Adam Wilke,** DC, Vice President, ***World Spine Care Europe***, Holmfirth, *United Kingdom.*
2. **Kuldip R Salgotra,** MS (Ortho), Lt. General**,** Director and Professor, Department of Orthopedics; Medical Superintendent/Hospital Director, ***MGM Hospital***, Kamothe, Navi Mumbai, *India.*
3. **Margareta Nordin,** Dr Med Sci, PT, Professor, Department of Orthopedic Surgery and Environmental Medicine, ***New York University***, New York, NY, USA.

   President, ***World Spine Care Europe***, Holmfirth, *United Kingdom.*
4. **Raghu Prasad Varma,** MS Orthopedics, DNB-Consultant Spine Surgeon**,** ***Fortis Hiranandani Hospital***, Mumbai, *India.*
5. **Rajani Mullerpatan,** PhD, PT, Professor and Director, MGM School of Physiotherapy, ***MGM Institute of Health Science***, Kamothe, Navi Mumbai, *India.*
6. **Sudhir N Kadam,** MRCP, FRCP; Medical Director, ***MGM Institute of Health Sciences***, Kamothe, Navi Mumbai, *India.*
7. **Shashank D Dalvi,** MBBS, MD (P & SM), Vice Chancellor, ***MGM Institute of Health Sciences***, Kamothe, Navi Mumbai, *India.*

Faculty

1. **Adam Wilke,** DC, Vice President, ***World Spine Care Europe***, Holmfirth, *United Kingdom.*
2. **Alberto Zerbi,** MD, EFM, Professor, Department of Radiology, ***University of Milan*** and Monza Bicocca. Chief, Department of Radiology ***IRCCS Institute Ortopedico Galeazzi***, Milan, *Italy.*
3. **Ashok Johari,** MS Orthopaedics, President of the ***Paediatric Orthopaedic Society of India*** (POSI) and the founding Vice-President of the ***Indian Academy of Cerebral Palsy*** (IACP), Mumbai, *India*.
4. **Carol Cancelliere,** DC, PhD, CCRF Research Chair in Knowledge Translation, Faculty of Health Sciences, ***University of Ontario Institute of Technology***, Toronto, ON, *Canada.*
5. **KS Gurung,** MPT, Therapy Unit Head, ***Green Pasture Hospital and Rehabilitation Centre,*** *Nepal.*
6. **Kuldip R Salgotra,** MS (Ortho), Lt. General**,** Director and Professor, Department of Orthopaedics; Medical Superintendent/Hospital Director, ***MGM Hospital***, Kamothe, Navi Mumbai, *India.*
7. **Manohar M Panjabi,** PhD; Professor Emeritus, Dept of Orthopedics and Rehabilitation and Mechanical Engineering, ***Yale University—Spine Biomechanics***, Boston, MA, *USA.*
8. **Margareta Nordin,** Dr Med Sci, PT, Professor, Department of Orthopedic Surgery and Environmental Medicine, ***New York University***, New York, NY, USA; President, ***World Spine Care Europe***, Holmfirth, *United Kingdom.*
9. **Pierre Côté,** DC, PhD Epidemiologist, Professor and Director of the ***University of Ontario Institute of Technology***—Canadian Memorial Chiropractic College (UOIT-CMCC), Centre for the Study of Disability Prevention and Rehabilitation, Toronto, *Canada*.
10. **Pradnya Girdhar,** MPT, Assistant Professor and Clinical supervisor, MGM's World Spine Care Clinic, ***MGM School of Physiotherapy***, Kamothe, Navi Mumbai, *India.*
11. **Rajani Mullerpatan,** PhD, PT, Professor and Director, MGM School of Physiotherapy, ***MGM Institute of Health Science***, Kamothe, Navi Mumbai, *India.*
12. **Satishchandra Gore;** MBBS, MS Orthopaedics, FABMISS, Minimally Invasive Spine Surgeon, Fellow of the ***American Board of Minimally Invasive Spine Surgery***
    Fellow of the ***Asian Academy of Minimally Invasive Spine Surgery.***
    Ex-President of the Asian Academy for Minimally Invasive Spine Surgery, Pune, *India.*
13. **Scott Haldeman,** DC, MD, PhD, FRCP, FAAN. President, ***World Spine Care***-Global Spine Care Initiative (GSCI), Santa Ana, CA, USA. Clinical Professor, Department of Neurology, ***University of California***, Irvine, CA, *USA*.

14. **S Rajasekaran,** MS, DNB, FRCS (ED), FRCS (LOND), MCH, FACS, PHD, **Chairman and Head, Department of Orthopedics and Spine Surgery,** ***Ganga Medical Centre & Hospitals Pvt Ltd***, Coimbatore, *India*.

15. **Yuvraj Singh,** MPT, Assistant Professor, ***MGM School of Physiotherapy***, Kamothe, Navi Mumbai, *India.*

CONFERENCE MANAGING COMMITTEE

Registration	Dr Juhi Bharnuke
Sponsorships and stalls	Dr Juhi Bharnuke Dr Shrutika Parab
Scientific Poster Corner	Dr Bela Agarwal Dr Meruna Bose
Travel and Accommodation	Dr Juhi Bharnuke Dr Mamta Shetty Dr Yuvraj Singh
MGM-WSC Clinic Activities	Dr PradnyaGirdhar
Banner and Conference Kit	Dr Ruturaj Shete
MGM CHMS Activity	Dr Triveni Shetty
Conference Proceeding	Dr Bela Agarwal Dr Juhi Bharnuke
Editorial Board	Prof Margarita Nordin Dr Rajani Mullerpatan Dr Adam Wilke Dr Bela Agarwal Dr Juhi Bharnuke Dr RP Dixit