

Premature degenerative shoulder changes in spinal cord injury patients

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Shoulder pain and the resultant dysfunction is an expected problem in individuals with spinal cord injury. But there is a remarkable lack of information about the natural history, diagnosis, prevention and long term outcomes. Degenerative changes may develop prematurely in their shoulders, due to overuse and altered mechanical stresses, with or without symptoms was the hypothesis of this prospective study. Information from this study is expected to assist in identification of high risk SCI individuals, and ultimately in development of preventive strategies.

The shoulders of 53 spinal cord injury patients from the onset of injury until 15 years duration were subjected to clinical and radiological examination at the Rehabilitation Institute of Chicago. Thirty-eight out of 53 (72%) patients demonstrated radiological evidence of degenerative changes, but only six (11%) complained of pain in the shoulders.

This study demonstrated a correlation between individuals with higher level of wheelchair activity (72%), higher age (92% above and 8% less than 30 years) and female gender (89% females *versus* 65% males) more prone to develop degenerative changes in the shoulders. Acromioclavicular joint was predominantly affected.

Detailed radiological findings, etiopathological factors and long term recommendations are discussed. The need for further studies and consistent management strategies are stressed.

Keywords: degenerative; etiopathological; mechanical stress; radiological; tetraplegia; spinal cord injury (SCI)

Introduction

Intensive medical care and comprehensive rehabilitation has enabled the spinal cord injured (SCI) person to live an active, productive life style to almost normal life expectancy. There is a general consensus that upper extremity pain is common in 1/3 to 1/2 of the SCI population which can interfere in their function and independence,^{1–6} yet there is little agreement as to the causes and management techniques. Literature review revealed some 22 retrospective reports with radiological changes in symptomatic patients with upper extremity pain.^{3,5,6} But others reported radiological changes in inactive rather than active individuals,⁷ rejecting the overuse theory proposed by Wing *et al.*⁸ All published reports indicate the need for further research.

The goal of this prospective study was to systematically assess the shoulders of wheelchair confined SCI person for longer duration, since the onset of injury up to at least for 5 years. The presence or absence of pain was not the criteria for inclusion in the study. All patients who were exposed to putative

mechanical forces of activities from wheelchair and agreed to participate in the study were included. Theoretically all patients were considered to be at high risk to develop degenerative changes in the shoulders due to altered function of upper extremities, weight bearing rather than prehensile and placement activities.

Subjects and methods

Fifty-three subjects, 33 who were tetraplegics and 20 paraplegic, 35 males and 18 females in age range of 19 to 81 years with mean age of 37 years participated in this study. All subjects were initially admitted as inpatients at the Rehabilitation Institute of Chicago (a national center for spinal cord injury) and then were followed in the outpatient department for minimum of 5 and maximum of 15 years.

The subjects were classified into four groups based on the age, gender, level of injury, and the level of wheelchair activities (Table 1). Tetraplegic patients were divided in high (C6 and above) and low (C6 to T1) groups (Table 2). Participants were classified in three groups based on their activities, manual wheelchair independent, manual chair dependant and

Table 1 Participant subjects

Subjects total	Age 19–81	Sex		HT	Injury level			Activity level		
		M	F		LT	PARA	WCD	WCI	MWU	
53	Mean 37 years	35	18	12	21	20	11	39	3	

HT, LT: High and low tetraplegia, PARA: Paraplegia, WCD and WCI: Wheelchair dependent and independent, MWU: Motorized wheelchair user

Table 2 Level of injury versus shoulder changes. Results

Level of injury	No. of subjects 53		Radiological changes	
	No.	%	Positive	Negative
High tetraplegia	12	22	8 (15%)	4 (8%)
Low tetraplegia	21	40	15 (28%)	6 (11%)
Paraplegia	20	38	15 (28%)	5 (9%)
	53	100	38 (72%)	15 (28%)

Thirty-eight out of 53, (72%) showed radiological changes in the shoulder joints, 30 out of 38 had low level tetraplegia and paraplegia

motorized chair users (Table 3). Two C6 patients with incomplete tetraplegia who were manual chair independent became partial ambulators with crutches and short leg braces for short distances. One paraplegic patient was using motorized chair due to associated complete brachial plexus injury of non-dominant upper extremity and was dependent for transfer activities.

Radiological assessment protocol

X-rays assessment of both shoulders was done in all 53 participants at the time of initial inpatient admission. Follow up X-rays were done within 6 months of discharge and then every 2 years in the outpatient department. This planned follow up protocol could consistently be accomplished in 60% of the cases. Additional X-rays were done out of the protocol in individuals with complaints of symptoms.

Results

These are summarized in Figure 1 and Tables 1,2,3, and 4. Age range of the participants was 19 to 81 with mean age 37, they were grouped into age higher and younger than 30 years. Individuals in higher age group demonstrated higher incidence of radiographic changes (Figure 1). Thirty-eight of 53 who developed X-ray changes, 35 of them (92%) were in higher and only three in the younger (8%) age group. Eight of 12 (15%) high, 15 of 21 (28%) low tetraplegia and 15 of 20 (28%) of paraplegia group developed degenerative X-ray changes (Table 2). Thirty-four of 39 (83%) manual wheelchair independent, three of 11 (27%) manual chair dependent and one of 3 (33%) motorized chair users demonstrated radiological changes in the X-rays (Table 3). Eighteen of 53 subjects were females, 15

SHOULDER, SCI

Results Cont: Age Versus Degenerative Changes

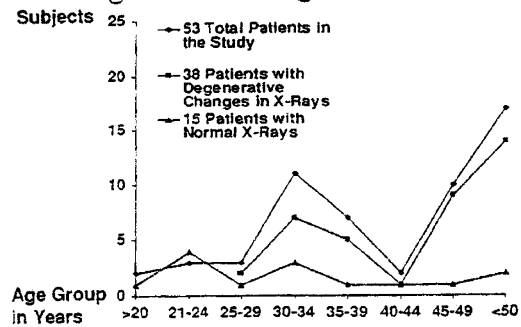


Figure 1 Mean age 37 years. Higher age subjects showed shoulder changes

Table 3 Activity level versus shoulder changes. Results

Activity level	Subjects number		Radiological changes	
	No.	%	Positive	Negative
Manual W.C. Depend.	11	20	3 (27%)	8 (15%)
Manual W.C. Independ.	37	70	32 (60%)	5 (9%)
Manual W.C. Ind. (Ambul)	2	4	2 (4%)	–
Motorized W.C. Users	3	6	1 (33%)	2 (4%)
	53	100	38 (72%)	15 (28%)

Thirty-nine out of 53 subjects were wheelchair independent and 34 of those had changes in the shoulder joints (87%)

Table 4 Sex versus degenerative shoulder changes. Results

Sex	Subjects		Degenerative changes	
	No.	%	Positive	Negative
Male	18	34	15 28% (F/F 83%)	3 6% (F/F 17%)
Female	35	66	23 43% (M/M 65%)	12 23% (M/M 35%)
	53	100	38 71%	15 29%

Fifteen out of 18 female subjects (83%) showed radiological joint change. Twenty-three out of 35 male subjects showed positive X-rays (65%). Percentages seems different when compared with all 53 patients

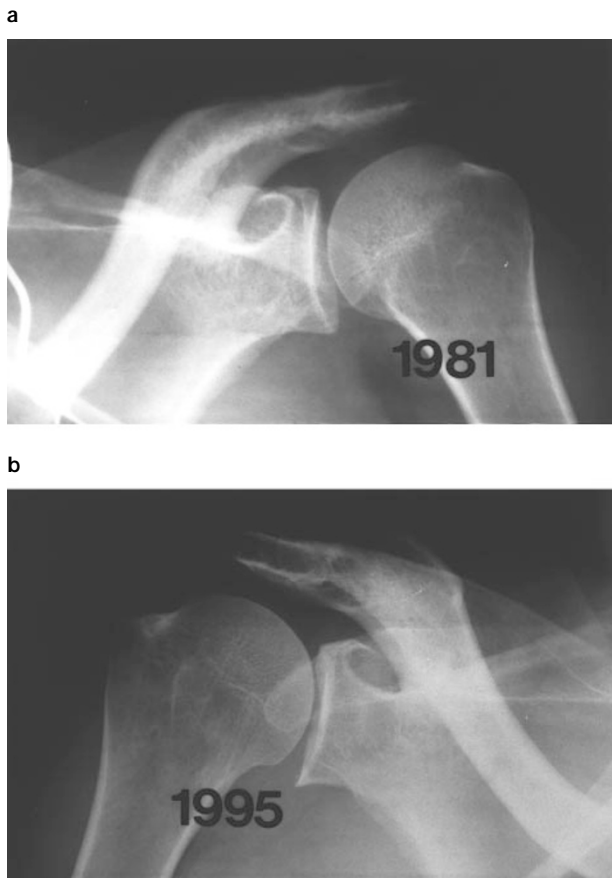


Figure 2 (a)VD 1981 C7 tetraplegia, 1 year post injury. Minimal achromioclavicular spur. (b) VD 1995 narrowing of glenohumeral achromioclavicular joint, spurs, impingement and superior subluxation of humeral head

(83%) of them and 23 of 35 males (66%) developed X-ray changes in their shoulders (Table 4). Interestingly only six of 53 (11%) participants developed shoulder pain. This prospective study was able to document relationships of higher incidence in higher age as proposed by Smith (1989).¹⁰

Earliest X-ray changes were noted 4 years after the injury in this group. Achromioclavicular joint narrowing (Figure 2a,b) was noted in all 38 subjects (100%), spur formation (39%), necrosis (34%), impingement (29%) were other significant findings.

Discussion

Upper extremity pain and deterioration of function is a common problem in a SCI population with a reported prevalence of 1/3 to 1/2, due to over use stress. Although the exact relationship is not clear shoulder dysfunction is thought to increase with age and time-since-injury. Various retrospective studies in the literature have documented conflicting reports. Only symptomatic SCI individuals were included in most of the studies. Nichols *et al* (1978)¹, Gellman *et al* (1988)²,

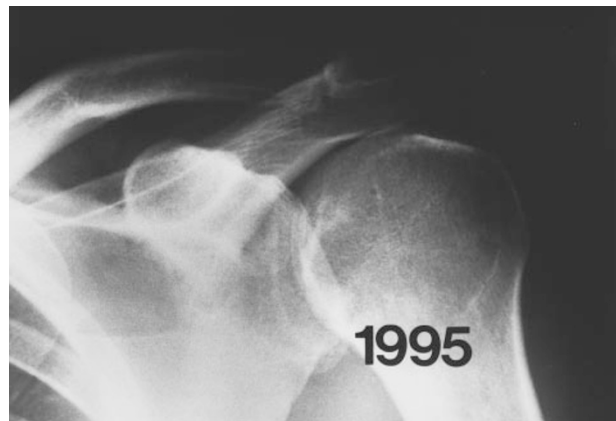


Figure 3 1995 DT C6 tetraplegia, partial ambulator 10 years post injury. Achromioclavicular changes, achromian spur, impingement. (1991 X-rays were normal)



Figure 4 AD C8 tetraplegia. 8 years post injury (Previous X-ray 1989 was normal). Achromioclavicular changes, cystic change humeral head with sclerosis, inferior subluxation of humeral

Subbarao (1994)⁴ and Sie *et al* (1992)⁹ reported pain in the upper extremities of SCI individuals in 1/3 to 1/2 of their patients based on clinical evaluation. Wing *et al* (1983)⁸ were not able to prove their overuse theory with no radiographic degenerative shoulder changes in their 10 crutch ambulators of mean age 23.7 years and duration of 8.7 years since injury. Contrary to the overuse theory Wylie *et al* (1988)⁷ demonstrated radiographic degenerative changes in their 12 of 38 inactive rather than active patients of 20 years duration.

This prospective study was able to document relationship of higher incidence in advanced age (Figure 1). Eight of 53 (15%) less than and 45 of 53 (85%) were of higher than 30 years of age. Three of eight (38%) and 35 of 45 (78%) subjects with degenerative changes (Figure 1) demonstrates the correlation of higher incidence with higher age. In relation to wheelchair activity 34 of 39 (87%)

independents *versus* (27%) dependents (Table 2) developed X-ray proven changes in the shoulders. Contrary to the previous reports pain in 30 to 60% only six of 53 (11%) reported some degree of pain.

Low incidence of pain can only be explained in those with tetraplegia due to impairment of shoulder nerve supply based on Charcot arthropathy Whitneck *et al* (1993)¹⁴ as nerve supply to the shoulder joint is from cervical segments (C4–C7) Hollinshead (1988).¹³ Higher incidence of X-ray changes in female gender 15 of 18 (83%) were observed in this study. No such gender prevalence in the literature has been reported though Pentland (1994)⁵ documented pain in the upper extremities associated with X-ray changes in 11 women was related with paraplegia as age and activity matched non paraplegic females did not develop pain or degenerative changes.

Acromioclavicular joint was found to be most susceptible in X-rays and was involved in all the affected shoulder joints (Figures 2a, b, 3 and 4). Other degenerative changes reported in the literature, spur formation in 39% (Figure 4), osteonecrosis (Figure 3) 34% (Barber *et al* 1996)⁶ and impingement (Figure 4) 29% (Bayley *et al* 1987),³ were also documented in the shoulder X-rays of subjects of this study. The radiological changes appeared to occur at an early stage than reported in the literature 4–5 years *versus* 10 years or longer.

Micro trauma to the cartilage resulting in elaboration of degradative enzymes and causing disturbance in cartilage repair mechanism is the normal process of degenerative joint disease Burr *et al* (1990),¹¹ which is initiated after second decade of life in aging McCarty *et al* (1993).¹² This degenerative process might have started in the higher age (30 years and above) group repetitive trauma and badly transmitted forces on the shoulder joint in wheelchair activities might have influenced the rapid progression of degenerative changes resulting into higher incidence of radiographic changes in this group.

Conclusion

The data from this study suggests that premature shoulder changes appear primarily in wheelchair users of advanced age in less than 10 years with predilection of Acromioclavicular joint. The female individuals may be at a higher risk. Further research is needed to

understand the exact etiopathological factors, their clinical relevance and plan for appropriate intervention. Strategy for clinical management was individualized in this study depending on the need of necessary equipment and assistance, to reduce the stress on the shoulders and acceptance by the participants.

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