

## Analyses of possible risk factors for subacromial impingement syndrome

Boonsin Tangtrakulwanich, Anucha Kapkird

Boonsin Tangtrakulwanich, Anucha Kapkird, Department of Orthopaedic Surgery, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand

**Author contributions:** Tangtrakulwanich B conceived and designed the study, performed the analysis and interpretation of data and prepared the manuscript; Kapkird A participated in data gathering. Both authors read and approved the final manuscript.

**Correspondence to:** Boonsin Tangtrakulwanich, MD, PhD, Department of Orthopaedic Surgery, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110,

Thailand. boonsin.b@psu.ac.th

Telephone: +66-074-451601 Fax: +66-074-212915

Received: September 28, 2011 Revised: December 15, 2011

Accepted: January 7, 2012

Published online: January 18, 2012

### Abstract

**AIM:** To evaluate the association between various risk factors, including sleeping position, and impingement syndrome. Impingement syndrome is the most common cause of shoulder problems. The pathogenesis of this problem is still debated these days.

**METHODS:** This was a case control study conducted at the outpatient clinic of Songklanakarind hospital. Data regarding history, physical examination and radiographic evaluations using supraspinatous outlet views were obtained from all patients with clinically suspected impingement syndrome. The diagnoses of impingement syndrome were confirmed by a xylocaine subacromial injection test. All patients were interviewed concerning their usual sleeping position, which was categorized into supine, decubitus, prone and undetermined. Radiographs were evaluated to determine the shape of the acromion, which was divided into 3 types: flat, curved and hook. We used logistic regression analysis to determine the association between risk factors and outcome.

**RESULTS:** The study group included 111 patients with

impingement syndrome and 191 healthy volunteers as a control group. The mean age was about 50 years with a body mass index (BMI) of 24 kg/m<sup>2</sup> in both groups. The most common shape of the acromion was flat (84.5%), followed by curved (10.7%) and hook (4.8%). We found the 4 independent risk factors affecting impingement syndrome were smoking status, occupation, acromion shape and sleeping position. Patients who currently smoked had a 6.8 times greater risk of impingement syndrome compared to non-smokers (OR 6.8, 95% CI: 1.2-39) and government officers had a 6.3 times increased risk compared to rubber tappers (OR 6.3, 95% CI: 1.3-30.3). Patients with a hook type acromion had 6.2 times the risk of flat type (OR 6.2, 95% CI: 1.1-35) and patients who slept in the decubitus position had 3.7 times the risk of those who slept in the supine position (OR 3.7, 95% CI: 1.2-11.6). No significant associations were found between age, sex, BMI, sports activity and impingement syndrome.

**CONCLUSION:** Independent risk factors affecting impingement syndrome are current smoker, government officer, a hook-type acromion and the decubitus sleeping position.

© 2012 Baishideng. All rights reserved.

**Key words:** Smoking; Decubitus; Impingement syndrome

**Peer reviewer:** Olaf Lorbach, MD, Saarland University, Department of Orthopedic Surgery, Kirrberger Str. D-66424 Homburg, Germany

Tangtrakulwanich B, Kapkird A. Analyses of possible risk factors for subacromial impingement syndrome. *World J Orthop* 2012; 3(1): 5-9 Available from: URL: <http://www.wjgnet.com/2218-5836/full/v3/i1/5.htm> DOI: <http://dx.doi.org/10.5312/wjo.v3.i1.5>

## INTRODUCTION

Impingement syndrome is the most common cause of shoulder pain<sup>[1-3]</sup>. The pathogenesis of impingement remains unknown. Both intrinsic and extrinsic factors have been claimed to be involved. The most significant previously reported factor associated with this condition was a hook type acromion. A previous study<sup>[4]</sup> reported a significantly higher incidence of a hook type acromion in cadavers with a rotator cuff problem. Other mechanical factors that might be related are repetitive overhead activities from work, such as working in a slaughterhouse, mechanics or painters<sup>[5,6]</sup> and sports such as volleyball, badminton or tennis have also been associated<sup>[6,7]</sup> with it. However, most previous studies have been descriptive studies. In addition, in our experience, we have observed that most patients complained that their symptoms were worse when they slept in the decubitus position. In addition, few previous studies have investigated the association between factors such as age, sex, body mass index or smoking status with this condition<sup>[8,9]</sup>. We hypothesized that these factors might be associated with impingement syndrome. The objective of this study was to identify factors associated with impingement syndrome.

## MATERIALS AND METHODS

This was a case control study. It was in compliance with the Helsinki Declaration and was approved by the ethics committee, Prince of Songkla University. All patients signed informed consent before participation. The setting was the outpatient clinic at Songklanagarind hospital during February 2008 to March 2009. The cases were patients aged between 30-60 years diagnosed with impingement syndrome, while the control group was healthy volunteers who were working in Songkhla province, aged between 30-60 years old without shoulder pain. The eligible patients all had at least a 6 wk history of shoulder pain, which occurred or increased during flexion and/or abduction, and with a positive Hawkins sign. Patients with a history of trauma, previous surgery or pregnancy were excluded. Clinically suspected patients were given a subacromion lidocaine injection test by one orthopedist to confirm the diagnosis. Diagnosis was established if shoulder pain improved by at least 50%. All included participants were interviewed by 1 orthopedist to ascertain basic demographic data, plus history of trauma, sports activity, smoking status and usual sleeping position before having shoulder pain, which was categorized into 4 positions: supine, decubitus, prone and undetermined. All participants were taken for a radiographic study in the supraspinatus outlet view by one trained musculoskeletal technician to determine the type of acromion, which was divided into 3 types: flat, curved and hooked. Radiographic interpretation was done by one musculoskeletal radiologist blinded to the clinical situation. Fifty set of radiographs were randomly selected for inter and intraobserver reliability test by two radiologists with one month

apart. The inter and intraobserver reliability were a moderate level of agreement according to Landis and Koch (Kappa = 0.46, 0.54, respectively)<sup>[10]</sup>.

## Statistical analysis

All descriptive data were summarized. Univariate analysis using the Chi-squared test was used to identify potential factors for multivariable analysis. Factors having a p-value less than 0.2, including sleeping position, were included for multivariable analysis using logistic regression analysis. Backward elimination technique was used to identify independent factors affecting impingement syndrome.

## RESULTS

Among the eligible patients with a confirmed diagnosis using an injection test, 82% agreed to participate in the study. There were 111 cases and 191 controls included in the study. The mean age was about 50 years with a body mass index (BMI) of 24 kg/m<sup>2</sup> in both groups. Most patients in this study were non smokers. The most common sleeping position was decubitus (55.1%), followed by supine (36.6%), with only 2 patients in this study sleeping in the prone position. The most common type of acromion was flat (84.5%), followed by curved (10.7%) and hooked (4.6%) (Table 1).

The study found several factors significantly associated with impingement syndrome in univariate analysis, including sex, smoking, occupation and sleeping position (Table 2).

Independent risk factors affecting impingement syndrome were smoking status, occupation, the acromion shape and sleeping position. Patients who currently smoked had 6.8 times greater risk of impingement syndrome than non-smokers (OR 6.8, 95% CI: 1.2-39.8) and government officers had 6.3 times the risk of rubber tappers (OR 6.3, 95% CI: 1.3-30.3). Patients with a hook type acromion had 6.2 times higher risk than flat type (OR 6.2, 95% CI: 1.1-34.9) and patients who slept in the decubitus position had 3.7 times the risk of those who slept supine (OR 3.7, 95% CI: 1.2-11.6). No significant association was found between age, sex, BMI, sports activity and impingement syndrome (Table 3).

## DISCUSSION

Four independent risk factors were found to be associated with impingement syndrome, including smoking, sleeping position, acromion shape and occupation.

Smoking has been proven to be a preventable risk factor associated with several health conditions, such as chronic lung disease, cardiovascular disease, malignancy and low back pain<sup>[11]</sup>. Our study demonstrated that participants who currently smoked had about 7 times the risk for shoulder impingement syndrome of nonsmokers. This could be related to the fact that nicotine can affect sensory thresholds, impair vasculature to tendons and disturb tendon healing capacity<sup>[11,12]</sup>. This tends to be con-

**Table 1** Patient characteristics of cases and controls

Characteristics	Cases <i>n</i> = 111 (%)	Controls <i>n</i> = 191 (%)	<i>P</i> -value
Mean age, yr (SD)	49.8 (7.7)	43.0( 6.2)	0.435
Gender, male (%)	49 (44)	101 (53)	0.03
Mean BMI, (kg/m <sup>2</sup> ) (SD)	24.1(3.8)	24.4 (3.6)	0.386
Smoking status (%)			< 0.05
Never	93 (83.8)	183 (95.8)	
Current	15 (13.5%)	4 (2.1)	
Ex-smoker	3 (2.7)	4 (2.1)	
History of trauma			< 0.05
No	104 (93.7)	191 (100)	
Yes	7 (6.3)	0 (0%)	
Occupation			< 0.05
Rubber tapper	11 (9.9)	20 (10.5)	
Teacher/nurse	30 (27.0)	34 (17.8)	
Farmer	9 (8.1)	14 (7.3)	
Officer/others	61 (55.0%)	123 (64.4)	
Sports			0.264
None	100 (90.1)	180 (94.2)	
-Football	1 (0.9)	4 (2.1)	
Jogging	3 (2.7)	0 (0)	
Others	7 (6.3)	8 (4.2)	
Sleeping position			0.029
Supine	85 (44.5)	32 (52.5)	
Decubitus	90 (47.1)	20 (32.8)	
Prone	2 (1.1)	0 (0)	
Undetermined	14 (7.3)	9(14.7)	
Type of acromion			0.082
Type I, Flat	89 (81.7)	166 (86.9)	
Type II, Curved	12 (11.0)	21 (11.0)	
Type III, Hooked	8 (7.3)	4 (2.1)	

BMI: Body mass index.

firmed by the fact that participants who had previously smoked but had quit prior to the study had essentially the same risk as nonsmokers.

Sleeping position is also a new risk factor we discovered from this study. Sleeping in the decubitus position showed a 3.7 times greater risk compared with sleeping in the supine position. The position of the shoulder while sleeping in the decubitus position is nearly similar to the position of the Hawkins provocative test, in which the shoulder in the forward flexion position can aggravate the impingement process. It is fair to hypothesize that repetitive overload from body weight during sleeping might cause the impingement of the tendon against the acromion arch, resulting in tendon degeneration and inflammation. The finding that the undetermined sleep position also indicated increased risk might also be explained by this, in that this group of patients indicated no predominant sleeping position, meaning they changed from one position to another during sleep, resulting in a lower risk than in patients who used the decubitus position predominately. We believe that the association found in our study might not be a spurious association or reverse causality, because the sleeping position reported was their common sleeping position be-

**Table 2** Univariate analysis of factors affecting impingement syndrome

Characteristics	Proportion of case <i>n</i> (%)	$\chi^2$ (df)	<i>P</i> value
Age, yr		1.83 (1)	0.175
< 50	25 (26.6)		
$\geq$ 50	69 (73.4)		
Sex		7.55 (1)	0.033
Male	44 (39.6)		
Female	67 (60.4)		
Smoking status		15.77	< 0.001
Never	93 (33.7)		
Current	3 (42.9)		
Ex-smoker	15 (78.9)		
Occupation		19.36 (6)	0.004
Rubber tapper	11 (35.5)		
Teacher/nurse	30 (48.4)		
Farmer	9 (39.1)		
Officer/others	61 (73.3)		
Sports		5.23 (4)	0.264
None	100 (35.7)		
Football	1 (20.0)		
Jogging	3 (50.0)		
Others	111 (60.0)		
Sleeping position		9.038	0.029
Supine	32 (27.4)		
Decubitus	70 (43.7)		
Prone	0 (0.0)		
Undetermined	9 (37.1)		
Type of acromion		4.99	0.082
Type I, flat	89 (34.9)		
Type II, curved	12 (36.4)		
Type III, hooked	8 (66.7)		
BMI (kg/m <sup>2</sup> )		0.489	0.783
< 25	68 (61.3)		
25-29.9	35 (31.5)		
$\geq$ 30	8 (7.21)		

BMI: Body mass index.

fore developing their shoulder problem. However, recall bias can not be totally obviated since participants who perceived their use of the decubitus sleeping position to be a causal factor might be more inclined to report this position.

Acromion shape has been blamed as a major cause for impingement syndrome without any good studies having been done to confirm this. All previous reports have only been descriptive studies<sup>[13-15]</sup>. Such studies have reported, for instance, a higher incidence of rotator cuff problems in a hook type acromion without statistical analysis. Our study did confirm this earlier observation. The magnitude of association between acromion shape and impingement was found to be as strong as the associations between smoking and occupation and the presence of disease. However, the proportion of hook types in our study was lower than in previous reports, which could be explained from the different characteristics of the study populations.

There are a number of occupations associated with impingement syndrome, such as a slaughterhouse worker,

**Table 3** Multivariable analysis demonstrating independent risk factors associated with impingement syndrome

Characteristics	Crude odds ratios (95% CI)	Adjusted odds ratios (95% CI)
Age, yr		
< 50	1	1
≥ 50	1.73 (1.01-2.96)	1.83 (0.87-3.81)
Sex		
Male	1	1
Female	0.58 (0.35-0.95)	0.58 (0.28-1.18)
BMI (kg/m <sup>2</sup> )		
< 25	1	1
25-29.9	1.01 (0.61-1.69)	1.31 (0.68-2.54)
≥ 30	1.41 (0.53-3.74)	1.13 (0.24-5.31)
Smoking status		
Never	1	1
Current	7.37 (2.30-22.86)	6.78 (1.15-39.82)
Ex-smoker	1.47 (0.32-6.73)	1.84 (0.34-9.93)
Occupation	1	1
Rubber tapper	1.70 (0.70-4.14)	0.81 (0.27-2.46)
Teacher/nurse	1.16 (0.38-3.56)	0.71 (0.18-2.73)
Farmer	5.00 (1.28-19.49)	6.28 (1.30-30.29)
Officer/others	0.74 (0.33-1.68)	0.44 (0.16-1.20)
Sport		
None	1	1
Jogging	1.80 (0.35-9.01)	2.60 (0.42-16.06)
Football	0.45 (0.05-4.08)	1.39 (0.11-17.29)
Others	2.70 (0.74-9.79)	2.81 (0.57-13.87)
Type of acromion		
Type I, flat	1	1
Type II, curved	1.06 (0.50-2.26)	1.10 (0.47-2.58)
Type III, hooked	5.73 (1.09-12.73)	6.24 (1.11-34.96)
Sleeping position		
Supine	1	1
Decubitus	2.06 (1.23-3.44)	3.74 (1.20-11.59)
Undetermined	1.71 (0.67-4.33)	2.35 (1.17-4.72)

BMI: Body mass index.

painter and ENT doctor<sup>[16,17]</sup>. Our study revealed that government officers also had a higher occupational risk associated with this problem compared with common occupations like rubber tappers. Repeated use in the abducted position of the shoulder during work might cause repetitive trauma to rotator cuff musculature. We did not find any significant association in teachers, but this could be explained by the decreasing use of overhead activities such as writing on a black/white board by teachers in modern classrooms. Also, the number of participants who were teachers was perhaps too low in this study to reliably detect an association.

The pathogenesis of impingement remains obscure from a limited number of studies on this aspect of this problem<sup>[5,18,19]</sup>. Our study highlighted, however, that impingement syndrome is possibly a preventable disease. Although multifactorial factors involving both biological and mechanical factors were encountered in the etiopathogenesis, preventable risk factors such as smoking, occupation and sleeping position could minimize the occurrence of this problem. However, further prospective

studies are needed to confirm these results.

Our study had some limitations. Firstly, we used a case control design to test the associations, which cannot ensure the temporal relationship for causation. Furthermore, our control group does have some differences in demographic characteristics. So, selection bias of the control group of healthy workers can affect both the direction and strength of the association. Secondly, the reliability of the determination of the shape of the acromion had only a moderate level of agreement and we did not test the reliability of types of usual sleeping position, so evaluation bias, which results from differences in the recall of cases and controls in amount and accuracy, cannot be obviated. Thirdly, as our hospital is a referral center, most of the patients generally have more severe disease than patients in other settings, so referral bias might limit the generalizability of the results.

In conclusion, this study reveals that smoking and sleeping in the decubitus position are new risk factors associated with impingement syndrome.

## ACKNOWLEDGEMENTS

The generous financial support by Faculty of Medicine, Prince of Songkla University is gratefully acknowledged.

## COMMENTS

### Background

Impingement syndrome is a potentially preventable shoulder problem. Previous studies reported that both biological and mechanical factors play a role in the etiopathogenesis.

### Research frontiers

The etiopathogenesis of impingement syndrome remains unclear. Only a few previous studies have evaluated the potential preventable risk factors associated with this problem.

### Application

The study highlights that impingement syndrome is possibly a preventable disease. Minimizing risk factors, including smoking and sleeping in the decubitus position, might reduce the occurrence of this problem.

### Terminology

Impingement syndrome is a clinical syndrome which occurs when the tendons of the shoulder muscles become irritated and inflamed as they pass through the subacromial space, resulting in pain, weakness and loss of movement at the shoulder.

### Peer review

This is an interesting study that evaluates factors that influence subacromial impingement syndrome.

## REFERENCES

- 1 **Chipchase LS**, O'Connor DA, Costi JJ, Krishnan J. Shoulder impingement syndrome: preoperative health status. *J Shoulder Elbow Surg* 2000; **9**: 12-15
- 2 **Kuijpers T**, van Tulder MW, van der Heijden GJ, Bouter LM, van der Windt DA. Costs of shoulder pain in primary care consultants: a prospective cohort study in The Netherlands. *BMC Musculoskelet Disord* 2006; **7**: 83
- 3 **Harrison AK**, Flatow EL. Subacromial impingement syndrome. *J Am Acad Orthop Surg* 2011; **19**: 701-708
- 4 **Buss DD**, Freehill MQ, Marra G. Typical and atypical shoulder impingement syndrome: diagnosis, treatment, and pit-

- falls. *Instr Course Lect* 2009; **58**: 447-457
- 5 **Bigliani LU**, Levine WN. Subacromial impingement syndrome. *J Bone Joint Surg Am* 1997; **79**: 1854-1868
  - 6 **Jobe FW**, Kvitne RS, Giangarra CE. Shoulder pain in the overhand or throwing athlete. The relationship of anterior instability and rotator cuff impingement. *Orthop Rev* 1989; **18**: 963-975
  - 7 **McCann PD**, Bigliani LU. Shoulder pain in tennis players. *Sports Med* 1994; **17**: 53-64
  - 8 **Palmer KT**, Syddall H, Cooper C, Coggon D. Smoking and musculoskeletal disorders: findings from a British national survey. *Ann Rheum Dis* 2003; **62**: 33-36
  - 9 **Tempelhof S**, Rupp S, Seil R. Age-related prevalence of rotator cuff tears in asymptomatic shoulders. *J Shoulder Elbow Surg* 1999; **8**: 296-299
  - 10 **Aladjem S**, Miller T. Effects of spontaneous and artificial membrane rupture in labour upon fetal heart rate. *Br J Obstet Gynaecol* 1977; **84**: 44-47
  - 11 **Gill CS**, Sandell LJ, El-Zawawy HB, Wright RW. Effects of cigarette smoking on early medial collateral ligament healing in a mouse model. *J Orthop Res* 2006; **24**: 2141-2149
  - 12 **Lincoln AE**, Smith GS, Amoroso PJ, Bell NS. The effect of cigarette smoking on musculoskeletal-related disability. *Am J Ind Med* 2003; **43**: 337-349
  - 13 **Sangiampong A**, Chompoopong S, Sangvichien S, Thongtong P, Wongjittaporn S. The acromial morphology of Thais in relation to gender and age: study in scapular dried bone. *J Med Assoc Thai* 2007; **90**: 502-507
  - 14 **Yamaguchi K**, Ditsios K, Middleton WD, Hildebolt CF, Galatz LM, Teefey SA. The demographic and morphological features of rotator cuff disease. A comparison of asymptomatic and symptomatic shoulders. *J Bone Joint Surg Am* 2006; **88**: 1699-1704
  - 15 **Ogata S**, Uhthoff HK. Acromial enthesopathy and rotator cuff tear. A radiologic and histologic postmortem investigation of the coracoacromial arch. *Clin Orthop Relat Res* 1990; **254**: 39-48
  - 16 **Svendensen SW**, Bonde JP, Mathiassen SE, Stengaard-Pedersen K, Frich LH. Work related shoulder disorders: quantitative exposure-response relations with reference to arm posture. *Occup Environ Med* 2004; **61**: 844-853
  - 17 **Frost P**, Andersen JH. Shoulder impingement syndrome in relation to shoulder intensive work. *Occup Environ Med* 1999; **56**: 494-498
  - 18 **Nirschl RP**. Rotator cuff tendinitis: basic concepts of pathoetiology. *Instr Course Lect* 1989; **38**: 439-445
  - 19 **McClure PW**, Michener LA, Karduna AR. Shoulder function and 3-dimensional scapular kinematics in people with and without shoulder impingement syndrome. *Phys Ther* 2006; **86**: 1075-1090

S- Editor Yang XC L- Editor Roemmele A E- Editor Yang XC