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Factors affecting response rates to mailed preoperative surveys among arthroplasty patients

Wenbao Wang, Jeffrey A Geller, Abraham Kim, Todd A Morrison, Jung Keun Choi, William Macaulay

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Abstract

AIM: To identify factors that affect patient response rates to preoperative functional surveys in hip and knee arthroplasty patients.

METHODS: From May 2008 to March 2009, 247 patients were scheduled more than 4 wk in advance for hip or knee arthroplasty by one of two participating surgeons at our center. A personalized questionnaire comprised of the Short Form 12 (SF-12) and Western Ontario and McMaster Universities (WOMAC) Index was mailed to patients at random time points ranging from 7 to 101 d prior to surgery. Nine independent factors were documented prospectively, including age, gender, ethnicity, marital status, type of surgery, surgeon, days prior to surgery (DPS) of survey mail-

ing, WOMAC score and SF-12 score. The date of the completed survey receipt was also documented. For non-responders, the surveys were completed with the research team at the hospital upon admission. Multivariate regression and χ^2 analysis were performed with Statistical Analysis Software software.

RESULTS: DPS was the only factor that affected patient response. Mailing surveys 26 d to 31 d prior to surgery dates led to a peak response rate of 80% that was significantly higher ($P < 0.023$) than response rates for patients who were mailed their surveys ≤ 16 d (62.5%), 17 d to 25 d (70%) or ≥ 32 d prior to surgery (55%). No other factors, including preoperative WOMAC and SF-12 scores, significantly influenced response behavior.

CONCLUSION: The DPS was independently the most significant predictor of response rates for pre-operative functional data among patients scheduled for hip and knee arthroplasty.

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Key words: Preoperative survey; Response rate; Factor analysis; Arthroplasty

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INTRODUCTION

Patient-completed questionnaires are widely used in the collection of clinical data in virtually all orthopedic subspecialties. A variety of patient self-reported outcome measures have been developed and utilized in each respective orthopedic discipline to assess outcome of orthopedic procedures, such as lower extremity total joint arthroplasty^[1-4]. Mailing self-reported outcome instruments is cost-effective for physicians and convenient for most patients^[5]. This popular method of obtaining outcome measures, however, is limited by survey non-responders who adversely affect data validity^[6]. Mailed surveys may be preferable for hip and knee arthroplasty patients who are demographically older and less likely to respond to internet or computer driven surveys. Additionally, paper surveys are often preferable as they are more Health Insurance Portability and Privacy Act (HIPAA) compliant.

Many studies have investigated strategies to improve patient response rates to postal questionnaires. A 2007 Cochrane Database review of 372 randomized control trials evaluated 98 factors that could potentially increase response rates. This study found that monetary incentives, recorded delivery, a teaser on the envelope and an interesting questionnaire topic doubled the odds of response rates, while pre-notification, follow-up contact, unconditional incentives, shorter questionnaires, providing a second copy of the questionnaire at follow-up, mentioning an obligation to respond and university sponsorship significantly increased the odds of response^[7]. Response rates among lower extremity total joint arthroplasty patients in particular are also influenced by immutable factors such as postoperative outcomes. Non-responders following knee arthroplasty were found to have poorer outcomes than responders in two separate studies^[8,9].

All aforementioned studies have examined ways to improve postoperative patient follow-up with mailed surveys. However, no such study on preoperative data collection exists in the literature. Preoperative general health and disease-specific assessments are equally important in that they provide essential baseline data for orthopedic outcomes research. This is an essential aspect to measuring the improvement that a surgical intervention may impart and how effective and reproducible it may be. Like postoperative follow-up questionnaires, preoperative surveys are also mostly mailed to patients for self-administration. The external and internal motivations and incentives for patients to complete self-administered surveys prior to orthopedic surgery, however, may be very different than those following surgery. Therefore, identifying factors that influence patient response rates prior to surgery is both novel and relevant to optimizing the validity of outcomes measures and further characterizing response behavior.

In this study, we prospectively evaluated the preoperative response behavior of completing a self-administered mail survey prior to undergoing routine knee and

hip arthroplasty based on nine social, functional and logistical factors hypothesized to influence response rates.

MATERIALS AND METHODS

From May 2008 to March 2009, 247 patients were scheduled more than 4 wk in advance for lower extremity joint arthroplasty, including total hip arthroplasty, total hip resurfacing, total knee arthroplasty, unicompartmental knee arthroplasty and bicompartiment knee arthroplasty, by two participating surgeons at our center. These patients comprised our prospective study cohort. A 53-item questionnaire comprised of the Short-Form 12 (SF-12) and Western Ontario and McMaster Universities (WOMAC) Index of osteoarthritis score as well as a personalized, signed letter explaining the questionnaire's purpose was enclosed in a stamped, hand-written envelope. The questionnaire and accompanying letter were mailed once to patients at random time points ranging from 7 to 101 d prior to surgery. Patients were instructed to return their completed surveys in non-stamped, pre-addressed envelopes included with the survey. No follow-up mailing or telephone calls were attempted with any patients. The date of completed survey receipt through the mail was also documented. For non-responders, the surveys were completed with the research team at the hospital on the day of admission.

Nine independent factors were documented prospectively, including age, gender, ethnicity, marital status, type of surgery, surgeon, days prior to surgery (DPS) of survey mailing, WOMAC score and SF-12 score. DPS was initially divided into ≤ 7 d, 8-10 d, 11-13 d, 14-16 d, 17-19 d, 20-22 d, 26-28 d, 29-31 d, 32-34 d and ≥ 35 d. It was then categorized by ≤ 16 d, 17-25 d, 26-31 d and ≥ 32 d for further statistical analysis.

Statistical analysis

Multivariate regression analysis was used to initially compare the effect of the nine aforementioned factors hypothesized to influence response rate. χ^2 analysis was subsequently used to determine statistical significance. All analyses were performed using Statistical Analysis Software 9.2 version (SAS Institute, Cary, North Carolina) with statistical significance set at $P < 0.05$.

RESULTS

The overall preoperative response rate was 70%, with 173 out of 247 patients responding. At baseline, responders and non-responders did not differ with respect to age, gender, ethnicity, marital status, type of surgery or surgeon (Table 1). Moreover, responders and non-responders had similar SF-12 physical subscores ($P = 0.41$), SF-12 mental subscores ($P = 0.7875$) and WOMAC score physical component ($P = 0.51$). DPS was the only factor in this investigation that affected patient response rates. Further analysis with the chi-square test (Figure 1) revealed that mailing surveys 26 d to 31 d prior to surgery dates led to a peak response rate of 80% that was

Table 1 Baseline characteristics of responders and non-responders

	Responders	Non-responders	Total	P value
Age (yr)	63.24 ± 12.89	63.89 ± 13.91	63.44 ± 13.18	0.7237
Gender (%)	Male 75/173 (43.35)	Male 38/74 (51.35)	Male 113/247 (45.7)	0.2495
Ethnicity (%)	White 103/173 (59.54)	White 53/74 (71.6)	White 156/247 (63.2)	0.0718
Marital status (%)	Married 93/173 (53.76)	Married 37/74 (50)	Married 130/247 (52.6)	0.5898
Type of surgery (%)	Hip 88/173 (50.87)	Hip 38/74 (51.35)	Hip 126/247 (51)	0.9447
Surgeon (%)	M 72/173 (41.62)	M 35/74 (37.3)	M 107/247 (43)	0.4114
SF-12 physical	30.04 ± 7.75	31.11 ± 10.16	30.30 ± 8.40	0.4074
SF-12 mental	49.24 ± 11.95	48.74 ± 11.49	49.12 ± 11.8	0.7875
WOMAC	47.30 ± 21.42	45.11 ± 22.69	46.76 ± 21.7	0.5122

SF-12: Short-Form 12; WOMAC: Western Ontario and McMaster Universities.

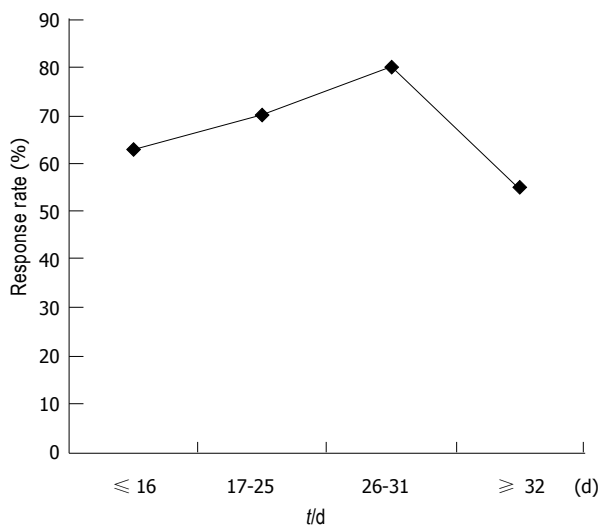


Figure 1 Response rate by survey mailing days prior to surgery (χ^2 , $P < 0.023$).

significantly higher ($P < 0.023$) than response rates for those who were mailed their surveys ≤ 16 d (63%), 17 d to 25 d (70%) or ≥ 32 d prior to surgery (55%).

DISCUSSION

In this study, we evaluated the response rates to self-administered questionnaires mailed prior to surgery among patients scheduled to undergo routine lower extremity total joint arthroplasty. To our knowledge, this has not been done for pre-operative patient outcomes measures. Among nine social, functional and logistical factors evaluated, the timing of questionnaire mailing prior to surgery was the only significant determinant of response behavior. Specifically, mailing of surveys 26 d to 31 d prior to surgery led to a peak response rate of 80% that was significantly higher than response rates outside this time period. Twenty-six to thirty-one days may afford patients the most amount of time or be most convenient to complete surveys while mentally anticipating and physically preparing for upcoming surgery. It is possible that earlier mailings may have a greater chance of being lost, while later mailings may not be completed in time.

Preoperative general health status and function did

not influence response behavior. It was presumed that given their need for lower extremity total joint arthroplasty, all patients were likely to have had similar significant disability that led them to schedule elective surgery. Therefore, factors other than physical pain, disability and function were suspected to affect response rate.

Surprisingly, our data showed many socioeconomic factors previously documented to affect response behavior in the literature did not affect response rate among responders to our questionnaire. Although socioeconomic status and literacy have been strongly correlated across ethnicities, our data did not show any significant correlation between ethnicity and response rates (Table 1). Marital status also did not affect the response rate despite its perceived role as a major social behavioral determinant (Table 1).

There were several limitations to this study that may affect the applicability of its findings. Firstly, there was no control group of patients to compare the behavior of lower extremity arthroplasty patients to that of the general population or other surgical patient populations both within and outside of orthopedic surgery. Secondly, there may be an as of yet unknown effect of our relatively limited sample size of 247 consecutive cases. However, although the sample size needed for an adequately powered factor analysis remains a controversial topic, there is no explicit recommendation in the literature about sample size. Instead, there is a wide range of what is considered to be adequate sample sizes. Costello and Osborne^[10] found that the majority of studies (62.9%) in peer-reviewed journals performed factor analyses with subject to variable ratios of 10:1 or less, with no trend towards journals with higher impact factors using higher ratios. Thus, with a subject to variable ratio of greater than 25:1, our sample size conferred adequate power for the multivariate regression analysis.

The present data show that optimal timing of patient-completed survey mailing at 4 wk prior to surgery yielded a higher response rate. Although this may not always be possible, i.e., some patients will be scheduled less than 31 d prior to surgery, this data may be helpful to researchers who decide upon resource allocation. Preoperative function and social factors may be less important than perceived as was demonstrated in this investigation. Nevertheless, identifying factors that de-

termine mailed survey response rate prior to surgery is important to decrease response bias and to improve the validity of both preoperative and postoperative data interpretation.

COMMENTS

Background

Patient-completed questionnaires are widely used in the collection of clinical data in virtually all orthopedic subspecialties. Mailing self-reported outcome instruments is cost-effective for physicians and convenient for most patients. Preoperative general health and disease-specific assessments provide essential baseline data for orthopedic outcomes research. However, this popular method is limited by survey non-responders who adversely affect data validity. There is no information in the literature on the success of this approach to data collection.

Innovations and breakthroughs

Many studies have investigated strategies to improve patient response rates to postal questionnaires and found many factors may affect the response rate. Response rates are also influenced by immutable factors such as postoperative outcomes. All previous studies have examined ways to improve postoperative patient follow-up with mailed surveys. However, no such study on preoperative data collection exists in the literature. Preoperative general health and disease-specific assessments are equally important in that they provide essential baseline data for orthopedic outcomes research. This is an essential aspect to measuring the improvement that a surgical intervention may impart and how effective and reproducible it may be. In this study, the authors prospectively evaluated the preoperative response behavior of completing a self-administered mail survey prior to undergoing routine knee and hip arthroplasty based on nine social, functional and logistical factors hypothesized to influence response rates.

Applications

This prospective evaluation demonstrated that the days prior to surgery was independently the most significant predictor of response rates for pre-operative functional data among patients scheduled for hip and knee arthroplasty. This data suggests that response rate may be significantly increased by selecting the optimal time to mail surveys.

Peer review

This is a well designed, well written, well structured paper, addressing the yet not studied issue of patient's response behavior regarding preoperative patients

derived outcome score questionnaires. It has a simple but important message for orthopedic outcome studies. The main study objective is relevant and useful for future research. The discussion is focused and well structured as well.

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Analyses of possible risk factors for subacromial impingement syndrome

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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/m² 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.

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Key words: Smoking; Decubitus; Impingement syndrome

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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^[1-3]. 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^[4] 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^[5,6] and sports such as volleyball, badminton or tennis have also been associated^[6,7] 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^[8,9]. 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)^[10].

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/m² 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^[11]. 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^[11,12]. 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 ²) (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 (4.7)	
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> (%)	χ^2 (df)	<i>P</i> value
Age, yr		1.83 (1)	0.175
< 50	25 (26.6)		
≥ 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 ²)		0.489	0.783
< 25	68 (61.3)		
25-29.9	35 (31.5)		
≥ 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^[13-15]. 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 ²)		
< 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^[16,17]. 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^[5,18,19]. 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.

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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

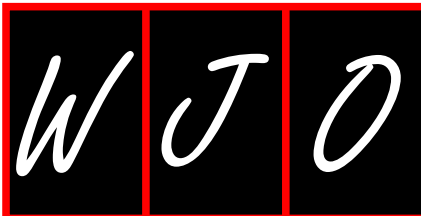
This is an interesting study that evaluates factors that influence subacromial impingement syndrome.

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February 7-11, 2012

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Surgeons
San Diego, CA, United States

February 14-15, 2012

7th National Conference:
Orthopaedics and Sports Medicine
2012 London, United Kingdom

February 16-19, 2012

Orthopaedic MRI and Small Parts
Scottsdale, AZ, United States

March 4-8, 2012

The 30th Annual Emergencies in
Medicine Conference
Utah, UT, United States

March 8-10, 2012

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Arthroplasty Course
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March 17-24, 2012

Orthopaedics and Sports Medicine
for Primary Care Practitioners

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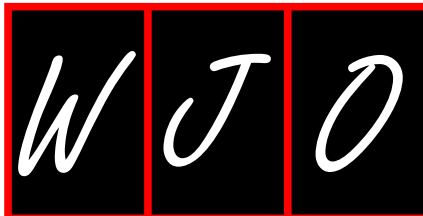
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- 3 **Tian D**, Araki H, Stahl E, Bergelson J, Kreitman M. Signature of balancing selection in Arabidopsis. *Proc Natl Acad Sci USA* 2006; In press

Organization as author

- 4 **Diabetes Prevention Program Research Group**. Hypertension, insulin, and proinsulin in participants with impaired glucose tolerance. *Hypertension* 2002; **40**: 679-686 [PMID: 12411462 PMID:2516377 DOI:10.1161/01.HYP.0000035706.28494.

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Both personal authors and an organization as author

- 5 **Vallancien G**, Emberton M, Harving N, van Moorselaar RJ; Alf-One Study Group. Sexual dysfunction in 1, 274 European men suffering from lower urinary tract symptoms. *J Urol* 2003; **169**: 2257-2261 [PMID: 12771764 DOI:10.1097/01.ju.0000067940.76090.73]

No author given

- 6 21st century heart solution may have a sting in the tail. *BMJ* 2002; **325**: 184 [PMID: 12142303 DOI:10.1136/bmj.325.7357.184]

Volume with supplement

- 7 **Geraud G**, Spierings EL, Keywood C. Tolerability and safety of frovatriptan with short- and long-term use for treatment of migraine and in comparison with sumatriptan. *Headache* 2002; **42** Suppl 2: S93-99 [PMID: 12028325 DOI:10.1046/j.1526-4610.42.s2.7.x]

Issue with no volume

- 8 **Banit DM**, Kaufer H, Hartford JM. Intraoperative frozen section analysis in revision total joint arthroplasty. *Clin Orthop Relat Res* 2002; (**401**): 230-238 [PMID: 12151900 DOI:10.1097/00003086-200208000-00026]

No volume or issue

- 9 Outreach: Bringing HIV-positive individuals into care. *HRS-A Careaction* 2002; 1-6 [PMID: 12154804]

Books

Personal author(s)

- 10 **Sherlock S**, Dooley J. Diseases of the liver and biliary system. 9th ed. Oxford: Blackwell Sci Pub, 1993: 258-296

Chapter in a book (list all authors)

- 11 **Lam SK**. Academic investigator's perspectives of medical treatment for peptic ulcer. In: Swabb EA, Azabo S. Ulcer disease: investigation and basis for therapy. New York: Marcel Dekker, 1991: 431-450

Author(s) and editor(s)

- 12 **Breedlove GK**, Schorfheide AM. Adolescent pregnancy. 2nd ed. Wiczorek RR, editor. White Plains (NY): March of Dimes Education Services, 2001: 20-34

Conference proceedings

- 13 **Harnden P**, Joffe JK, Jones WG, editors. Germ cell tumours V. Proceedings of the 5th Germ cell tumours Conference; 2001 Sep 13-15; Leeds, UK. New York: Springer, 2002: 30-56

Conference paper

- 14 **Christensen S**, Oppacher F. An analysis of Koza's computational effort statistic for genetic programming. In: Foster JA, Lutton E, Miller J, Ryan C, Tettamanzi AG, editors. Genetic programming. EuroGP 2002: Proceedings of the 5th European Conference on Genetic Programming; 2002 Apr 3-5; Kinsdale, Ireland. Berlin: Springer, 2002: 182-191

Electronic journal (list all authors)

- 15 Morse SS. Factors in the emergence of infectious diseases. Emerg Infect Dis serial online, 1995-01-03, cited 1996-06-05; 1(1): 24 screens. Available from: URL: <http://www.cdc.gov/ncidod/eid/index.htm>

Patent (list all authors)

- 16 **Pagedas AC**, inventor; Ancel Surgical R&D Inc., assignee. Flexible endoscopic grasping and cutting device and positioning tool assembly. United States patent US 20020103498. 2002 Aug 1

Statistical data

Write as mean \pm SD or mean \pm SE.

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