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Original article

Internal impingement of the shoulder: An international survey of 261 orthopaedic surgeons

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ABSTRACT

Background: Internal impingement of the shoulder (IIS) is a specific disorder of young overhead-throwing athletes that was first described in 1991. The many non-operative and surgical treatments suggested to date have produced mixed outcomes. The objective of this study was to compare the practices of surgeons in France versus other countries regarding the diagnosis and treatment of IIS.

Hypothesis: Diagnostic and therapeutic practices regarding IIS differ between surgeons in France and in other countries.

Material and methods: A 21-item questionnaire in French and English was emailed to the 1300 members of the French Arthroscopy Society and to surgeons from countries other than France. The questionnaire collected information on knowledge about IIS (2 items), the frequency of IIS in clinical practice (2 items), the diagnosis of IIS (6 items), the non-operative and surgical treatment of IIS (3 and 5 items, respectively), and return-to-sports rates after treatment for IIS (3 items).

Results: The completed questionnaire was sent back by 261 surgeons, 206 in France and 55 in other countries, including 42 in Japan. Among the respondents, 90% knew about IIS. Experience with IIS in terms of number of patients seen or surgical treatments performed was greater in the international group (45% vs. 19% in France, $p < 0.001$). Posterior shoulder pain in the arm cocking position was the most widely recognised symptom (99% in France, 74% internationally, $p < 0.001$), followed by excessive external rotation during arm abduction (55% vs. 65%, $p = 0.23$). The most commonly sought lesions were those of the postero-superior labrum and articular surface of the rotator cuff. Rotator cuff debridement was among the surgical options according to most respondents (74% vs. 70%). In contrast, postero-superior glenoidplasty was cited almost only by surgeons in France (67% vs. 4%, $p < 0.001$). The proportion of patients who are able to return to sports was estimated at 50% to 75% by most respondents.

Discussion: Most respondents had theoretical knowledge about IIS, but surgery was rarely performed in France. Only very few athletes in France play baseball, which is responsible for most sports injuries of the shoulder seen in Japan. This fact, combined with differences in the lesions or even the diagnoses, may have contributed to the differences in the responses to the survey items between the French and international groups.

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1. Introduction

Internal impingement of the shoulder (IIS) was first described by Gilles Walch in 1991 in the *Revue de chirurgie orthopédique et réparatrice de l'appareil locomoteur* [1]. He defined IIS as abutting of the supraspinatus undersurface and postero-superior glenoid labrum in young overhead-throwing athletes (chiefly, handball and tennis players). Subsequently, surgeons in the US reported that IIS was common in baseball players and suggested a number of biomechanical hypotheses. Knowledge of the pathophysiological factors involved has expanded over the past two decades [2–5]. Nevertheless, IIS remains uncommon in the general population as it occurs almost only with repeated arm cocking and overhead throwing (baseball, tennis, volleyball, handball, and javelin throwing) [6]. As athletes practising these sports are managed by a limited number of physicians and surgeons, IIS is a rare diagnosis for most orthopaedic surgeons. Finally, many non-operative treatments [7–9] and surgical procedures [10–13], chiefly performed arthroscopically, have been developed. Their outcomes, however, are mixed and difficult to predict, particularly regarding the return to the same sport, which is the main goal for the patients.

The low incidence and complexity of IIS prompted the French Arthroscopy Society (*Société Française d'Arthroscopie*) to survey surgeons about IIS during a symposium on this condition. The objective

of this survey was to compare the diagnostic and therapeutic practices of surgeons in France versus other countries. The working hypothesis was that diagnostic and therapeutic practices regarding IIS differ between surgeons in France and in other countries.

2. Material and methods

We conducted an international survey among orthopaedic surgeons who were SFA members or worked in countries other than France. An invitation to complete an online questionnaire was sent to the 1304 SFA members (French group) whose electronic address was available. Shoulder surgeons working outside France whose addresses were provided by personal contacts were sent the same invitation (international group). Non-respondents received an email reminder a few weeks after the initial invitation.

2.1. Questionnaire

A 21-item questionnaire in French and English was developed for the survey (Table 1) to collect data on the following points: knowledge about IIS (2 items), frequency of IIS in clinical practice (2 items), diagnosis of IIS (6 items), non-operative and surgical treatment of IIS (3 and 5 items, respectively), and return-to-sports rates

Table 1
Questionnaire in English and response rate for each item.

#	Question	Answers France (%)	Answers International (%)
Knowledge and Prevalence			
1	Have you ever heard about the internal impingement in the throwing shoulder?	99.5%	100.0%
2	Do you think the internal impingement (or internal conflict) merely exists?	99.5%	100.0%
3	How many patients involved in a sport with regular throwing do you approximatively see in OPD every year? (All cases included: with or without a throwing shoulder problem)	100.0%	100.0%
4	How many cases of internal impingement do you see in OPD every year?	90.3%	90.9%
Diagnosis			
5	To your opinion, is pain the main complain of the patient suffering from an internal impingement?	87.4%	90.9%
6	How would you describe the pain?	86.9%	65.5%
7	What are, to your opinion, the main characteristics of the clinical examination in those patients?	84.0%	87.3%
8	What, in your own practice, do you always ask in terms of imaging for those patients?	88.3%	89.1%
9	Do you always look for a glenoid bony spur (Bennett's lesion)?	88.3%	89.1%
10	To your opinion what lesions are mostly significant of an internal impingement?	87.9%	89.1%
Medical Treatment			
11	Do you ever propose an intra-articular corticosteroid injection in those patients?	88.3%	89.1%
12	What kind of post-operative physiotherapy do you advise for those patients?	81.6%	89.1%
13	Do you always advise preoperative physiotherapy?	86.4%	87.3%
Surgical Treatment			
14	Do you propose surgery for those patients?	86.9%	89.1%
15	How many of those patients do you operate per year?	88.8%	89.1%
16	In case of surgery, have you ever been confronted to preoperatively non-expected/non detected lesions (SLAP lesion, anterior Bankart lesion, other)?	71.8%	83.6%
17	Did the presence of unexpected lesion change your surgical procedure?	61.2%	81.8%
18	What do you specifically propose for the surgical treatment of internal impingement?	69.9%	83.6%
Clinical Results			
19	After surgical treatment, how many of your patients did return to their previous overhead or throwing sport?	65.0%	81.8%
20	After surgical treatment of the internal conflict associated with a cuff repair, how many of your patients did return to their previous overhead or showing sport?	59.7%	65.5%
21	After surgical treatment, how many of the patients who returned to their previous sport could achieve the same or superior level of play?	60.2%	81.8%

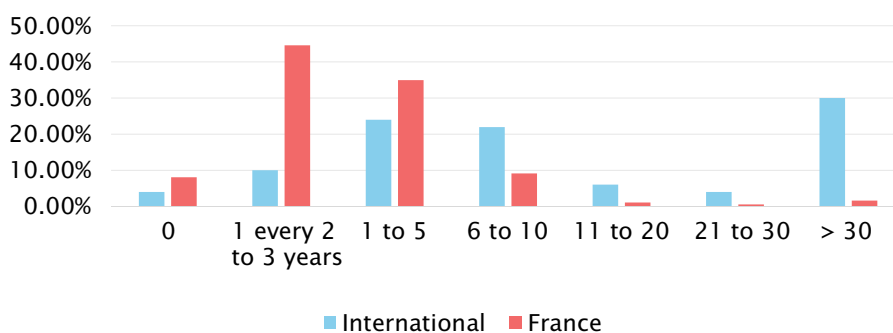


Fig. 1. How many patients with internal impingement of the shoulder do you see each year?

(3 items). For each item, respondents were asked to choose one or more answers in a list. There were no open-ended items.

2.2. Data collection and analysis

The surgeons were invited to complete the questionnaire on the SurveyMonkey platform (www.surveymonkey.com), which allows anonymous data collection. The responses were consolidated for each item, with no chaining of items and responses.

2.3. Statistical analysis

For each response, the percentage was computed with the number of respondents as the denominator, without taking missing responses into account. Responses in the French and international groups were compared by applying the z test for comparing proportions. Values of $p < 0.05$ were taken to indicate significant differences. The statistical analysis was conducted using R version 3.4.3 (www.r-project.org).

3. Results

3.1. Survey response and questionnaire completion rates

Of the 1304 SFA members, 206 (15.8%) sent back completed questionnaires. All 206 worked in France (French group). Completed questionnaires were also sent back by 55 surgeons working outside France (international group), including 42 (76%) in Japan, 5 in India, 4 in Switzerland, 1 in the UK, 1 in the US, and 2 in unspecified countries.

Among respondents, the mean proportion of answered items was 82% (range, 60–100%) in the French group and 86% (range, 66–100%) in the international group (Table 1).

3.2. Knowledge about IIS and frequency of IIS in clinical practice

Over 90% of respondents were aware of IIS, with no noticeable difference between the two groups (97% and 93% in the French and international groups, respectively; $p = 0.17$). Nearly 90% of respondents viewed IIS as a clinico-pathological entity (90% vs. 89%, $p = 0.83$). Only the respondents who gave an affirmative answer to this last question were invited to continue completing the questionnaire.

In France, 36% of respondents saw over 20 overhead-throwing athletes each year, compared to 56% internationally ($p = 0.006$). Similarly, the proportion of respondents who saw at least 1 patient with IIS each year was 47% in the French group and 86% in the international group ($p < 0.001$) (Fig. 1).

3.3. Clinical diagnosis

Most respondents considered that pain was the main symptom of IIS, with a higher proportion in France than internationally (99% vs. 74%, $p < 0.001$). The pain was usually described as located in the posterior shoulder and occurring during arm cocking (67% vs. 68%, $p = 0.87$). The following symptoms were reported also: superior labrum from anterior to posterior (SLAP) tears (3 respondents), instability (2 respondents), decreased throwing height (2 respondents), discomfort (1 respondent), and stiffness (1 respondent).

The abnormalities most often sought during the physical examination were: excessive external rotation with the arm abducted (55% in France and 65% internationally, $p = 0.23$); decreased internal rotation with the arm abducted (41% vs. 46%, $p = 0.44$); apprehension during arm cocking (42% vs. 13%, $p < 0.001$); a positive Jobe's relocation test (19% vs. 17%, $p = 0.71$); Jobe's sign (18% vs. 8%, $p = 0.11$); and a positive palm-up test (7% vs. 10%, $p = 0.42$).

3.4. Imaging studies

The preferred imaging studies differed between the two groups, with French surgeons predominantly relying on computed tomography-arthrography (67% vs. 6% internationally, $p < 0.001$) and international surgeons on magnetic resonance imaging (MRI) (49% vs. 31% in France), MRI-arthrography (41% vs. 19% in France), and ultrasonography (29% vs. 8% in France).

A postero-superior glenoid spur was looked for routinely by 54% and 59% of respondents in the French and international groups, respectively ($p = 0.51$). The other abnormal imaging findings deemed consistent with IIS were tearing of the postero-superior labrum (91% in France vs. 63% internationally, $p < 0.001$), rotator cuff tears (71% vs. 47%, $p = 0.002$), SLAP tears (22% vs. 49%, $p < 0.001$), glenoid cartilage lesions (24% vs. 8%, $p = 0.014$), and a bone cyst in the glenoid (29% vs. 4%, $p < 0.001$) or greater tuberosity (37% vs. 6%, $p < 0.001$).

3.5. Non-operative treatments

An intra-articular injection to relieve the pain was prescribed by most respondents in both groups (91% in France and 88% internationally; $p = 0.47$). However, the use of an intra-articular analgesic injection as the routine first line treatment was far more common in France than internationally (60% vs. 20%, $p < 0.001$).

Physical therapy was prescribed before considering surgery by all respondents but 6, all in France, who advocated first-line surgery in patients with rotator cuff tears or failed adaptation of the throwing technique. The main components of physical therapy were stretching with the arm internally rotated and abducted (60% in France vs. 78% internationally, $p = 0.02$), scapular stabilisation exercises (53% vs. 88%, $p = 0.01$), and eccentric strengthening exercises with the arm externally rotated and abducted (56% vs. 41%, $p = 0.06$).

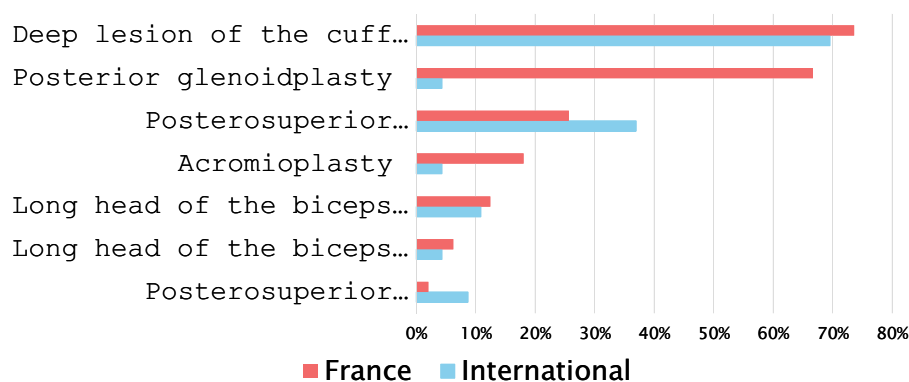


Fig. 2. What surgical procedures do you perform in patients without concomitant lesions (rotator cuff tears excluded)?

3.6. Surgical treatment

Surgery was among the treatment options considered by 73% of respondents in France and 88% internationally ($p=0.06$). Only 2 respondents (both in France) routinely recommended surgery for IIS. The proportion of respondents who had never performed surgery to treat IIS was higher in France than internationally (38% vs. 14%, $p=0.002$). Similarly, the proportion of respondents who performed surgery for IIS at least once a year was only 19% in France compared to 45% internationally ($p<0.001$).

The identification of unexpected abnormalities such as a SLAP tear or Bankart lesion during surgery was reported by 36% of respondents in France and 63% internationally ($p=0.001$). A change in the surgical strategy due to the presence of these lesions was reported by 46% and 60% of respondents in the French and international groups, respectively.

In the absence of a rotator cuff tear involving more than 50% of the thickness of the tendon, the most commonly reported procedure was cuff debridement, both in France and internationally (74% vs. 70%, $p=0.60$). Glenoidplasty combined with posterior capsulotomy as described by Lévine was performed almost only in France (67% vs. 4%, $p<0.001$). Acromioplasty was also performed more often in France (18% vs. 4%, $p=0.02$), whereas isolated procedures on the capsule were reported more commonly in the international group (Fig. 2).

3.7. Return to sports after surgery

The proportion of respondents reporting that a return to the same sport was possible for at least 50% of patients was 68% in the French group and 87% in the international group ($p=0.015$). Few respondents reported that a return to the same sport was possible for more than 75% of patients, and again the proportion was lower in France (19% vs. 42%, $p=0.002$) (Fig. 3A). The proportion reporting that the return was at the same level or at a higher level was 42% in France and 73% internationally ($p<0.001$) (Fig. 3B).

4. Discussion

Although IIS is a rare condition that is encountered by only a limited number of surgeons, nearly 90% of the respondents demonstrated substantial knowledge about this entity and the challenges it raises. In practice, however, IIS is uncommon in France, with 50% of surgeons reporting fewer than 1 case per year.

Internationally, in contrast, 62% of respondents reported seeing more than 5 cases each year. This difference between the two groups is probably ascribable to selection bias, as the international surgeons invited to participate in the survey were all shoulder specialists, whereas all SFA members regardless of specialisation were invited.

The further differences between the two groups identified by the next questionnaire items probably reflect differences in the most popular sports across countries. In France, most overhead-throwing athletes play volleyball, handball, or tennis [13,14]. In Japan, where 76% of the international surgeons worked, baseball was introduced in 1872 and remains extremely popular [15]. Searching the PubMed database with the indexing terms 'baseball' and 'Japan' retrieved 380 publications. Moreover, an item included only in the English version of the questionnaire, and for which the results are not reported here as it obtained only 10 responses, indicated that 60% to 100% of overhead-throwing athletes seeking advice for shoulder disorders were baseball players. Several studies have established that the kinetic and biomechanical characteristics of the throwing motions used by baseball pitchers are highly distinctive and carry a risk not only of IIS but also of SLAP tears [8,16,17,18]. Thus, the lesions present in IIS may differ between patients in France and those in other countries, explaining why surgeons in France suspect IIS when a labral injury coexists with damage to the cuff undersurface, whereas surgeons working elsewhere also consider a diagnosis of IIS when SLAP tears are found. In addition, the fact that the vast majority of reports of the clinical outcomes of treatments for IIS were performed in baseball players probably influences the identification of the condition. Our finding that only a tiny minority of international surgeons (4% to 8%) looked for glenoid cartilage damage or bone cysts in the glenoid or greater tuberosity, compared to 24–37% of surgeons in France, suggests that these abnormalities may be unrecognized or absent in baseball players.

Whereas posterior shoulder pain was universally recognized as the key symptom of IIS, only half of the respondents indicated that passive motion range abnormalities were specific of the disorder. These changes in passive motion are not described in French articles on IIS but are reported in studies from the US and may be present in most baseball pitchers. The other clinical signs were correctly indicated by less than 20% of respondents.

Nearly all the respondents felt that non-operative treatments had a larger role to play than surgery and that their main goals were to stretch the posterior capsule and strengthen the posterior muscles. Intra-articular injections were used more often in

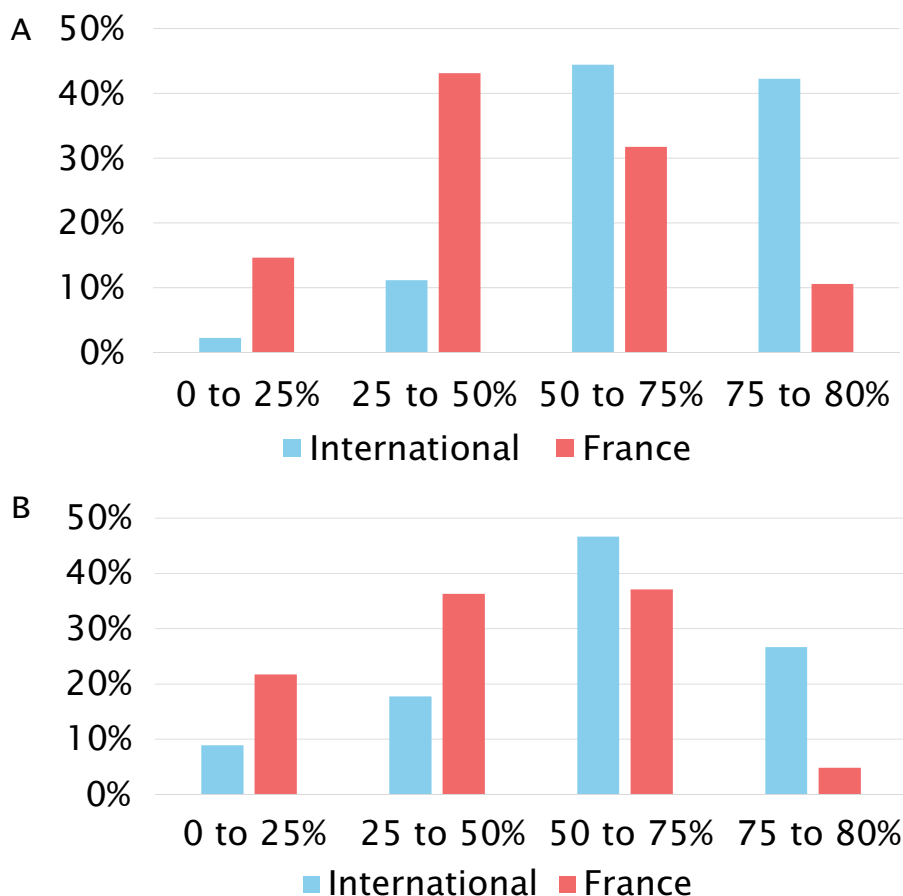


Fig. 3. A: In your experience, what percentage of patients return to play after surgery?; B: In your experience, among patients who return to play, what percentage returns to the same or a higher level?

France, probably due to greater reluctance to perform surgery in these young patients, a strategy reported by only 19% of respondents in the French group compared to 45% in the international group.

Differences in surgical techniques were identified between the two groups. Thus, glenoid reconstruction was often viewed as a viable option in France [13] but was performed by only 2 of the international respondents. We omitted to collect information on superior labrum repair. Differences on this point might have confirmed the differences in the prevalence of SLAP tears.

Finally, the 50% to 75% estimated return-to-sports rate is consistent with earlier findings [10,12,13]. The estimated return-to-sports rate was slightly higher among the international respondents, reflecting their greater experience with IIS. Issues also arise regarding the diagnosis of IIS outside France, given the differences in anatomical lesions. Thus, in the early studies of IIS done in the US, some patients had shoulder instability and were managed by anterior capsule reconstruction. The misclassification of these patients as having IIS may have led to overestimation of the benefits of surgery in IIS.

To our knowledge, this is the first survey of practices regarding IIS among orthopaedic surgeons. The low response rate (15.8%) among SFA members suggests that our sample may not have been representative of all orthopaedic surgeons in France. Nevertheless, the sample size is large and the results suggest that many surgeons were specialised in the shoulder. The 206 SFA members who participated in the survey may represent a large proportion of shoulder surgeons in France, since the French Shoulder and Elbow Society (*Société française de l'épaule et du coude*, SOFEC) has 245 members.

The responses made by the international surgeons suggest that international articles on disorders in overhead-throwing athletes should be read with great care. However, it is worth noting the following remark made (in English) by one of the respondents: 'Baseball is a unique sport [...] the results of this survey and treatments for all other overhead-throwing athletes should not be generalised to baseball.'

Disclosure of interest

C. Levigne is a consultant for and receives royalties from Wright/Tornier.

J. Grimberg is a consultant for Smith & Nephew and receives royalties from Biomet-Zimmer.

P. Clavert is a consultant for and receives royalties from Wright/Tornier.

J. Kany is a consultant for Vims.

J. Garret is a consultant for Arthrex, Zimmer, and Pfizer and receives royalties from Move UP Ortho, Wright, and FH Orthopedics.

The other authors declare that they have no competing interest.

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Contributions of each author

All authors contributed equally to the preparation of the manuscript.

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