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JST inaugural editorial

It is customary to launch new journals either by staking a claim for a genuinely new terrain, or by identifying the need for a new approach to the analysis of familiar themes. In many ways, we are pleased that the first edition of the *Journal of Sports Therapy* does not privilege either of these rationales, but rather offers itself as a vehicle to coterminously serve both purposes, and more. Put simply, the academic study and professional practice of sports therapy has not, until now, had a dedicated outlet for the dissemination of theoretical development and empirical elaboration.

As an online academic medium, it is hoped that the *Journal of Sports Therapy* (JST) will not only provide an outlet for seasoned sports therapy academics and practitioners to engage in meaningful exchange of knowledge, but will also build the scale and scope of its coverage to encourage both new and experienced academics, and students, to develop their individual careers, and further the purposes and wider awareness of the discipline itself. These imperatives are, of course, brought sharply into focus as we witness the growth in the provision of sports therapy degree programmes and the attendant research demands placed upon such a nascent discipline.

While it is acknowledged that Sports Therapy is now very much an identifiable discipline with its own academic and professional aspirations, it is also important to consider the need for our new journal to also nurture and embrace relevant, and appropriate, inter-disciplinary relationships. Among these, Physiotherapy, Sports Management, Sports Science, and Sports Psychology are obvious potential partners, but also we envisage possible contributions from further afield, such as Business Studies and Economics.

With the foregoing in mind, allow me to invite contributions for our forthcoming issues. At the moment, the next issue of JST, volume 2, issue 1, is almost fully subscribed, so can ask all potential contributors to submit early for the second issue of volume 2? All contributions are initially peer reviewed, and following this are considered by the editorial panel before publication. Please see notes to contributors and details of the editorial panel on the pages at the back of this issue.

I look forward to a long and successful collaboration with all our associated institutions and colleagues.

David Jenkins

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Acromio-Clavicular Injuries: A Review.

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Abstract

Acromio-clavicular (ac) joint injuries make up 12% of shoulder dislocations (Cave, 1961) and 20% of all shoulder injuries will involve this joint (Kocher et al; 1998). It is reported that 45% of ice hockey players in the USA will have had an ac joint injury (Norfray et al; 1997)

Injuries are generally graded between grades I – III with a grade III ac joint injury involving total separation of the acromio-clavicular and both the trapezoid and conoid portions of the Coracoclavicular ligaments, usually in the midsubstance of the ligament (Rockwood et al 1996).

Following injury immobilisation of the joint coupled with load deprivation causes rapid deterioration of the ligamentous tissue (Frank 1996; Butler et al 1978) along with a decrease in collagen mass (Ameil et al 1982) and stiffness (Noyes et al 1974).

Introduction

This brief article aims to describe the diagnosis of acromio-clavicular joint separations in the UK using academic articles extracted from journals and other sources.

Methodology

In order to obtain the relevant information an internet search was undertaken using the Athens network, as well as search engines such as Pubmed, Sage, Science Direct and Google Scholar. The search used the keywords shoulder, injury, separation acromion-clavicular joint, acromion, clavicle and sports. Articles used came from peer reviewed academic journals such as American Journal of Sports Medicine, British Journal of Sports Medicine etc. Initially only articles from 1997 to 2006 were considered but earlier articles were then used as much of the current literature referred to articles from the 1970s and 1980s particularly when considering the biomechanical and physiological properties of the joint itself. Some textbooks were also used, notably the 35th edition of Gray's Anatomy to give the anatomical definition of the joint.

Joint Anatomy/Mechanism of Injury

The acromio-clavicular (ac) joint is the junction between the acromion process of the scapula and the distal end of the clavicle. It is described as a plane synovial joint and is surrounded by the joint capsule and supported by the Acromio-clavicular and Coracoclavicular ligaments, the latter ligament being divided laterally into the trapezoid portion and medially into the conoid portion (Gray's Anatomy; 1978).

The Acromio-clavicular ligament reinforces the joint superiorly lying above the joint capsule with attachments at the distal end of the clavicle and the superior aspect of the acromion. The Coracoclavicular has two attachments on the inferior surface of the clavicle the distal one third of the inferior surface (the trapezoid portion) and the middle one third of the posterior surface (the conoid portion) both of which share an attachment on the supero-anterior surface of the coracoid process of scapula.

Sprains of the ac joint are generally graded from I to III with III being a complete separation of the joint ligaments and superior displacement of the distal end of clavicle both clinically and radiographically (Peterson & Renstrom; 1986). A grade III strain is often referred to as a shoulder separation and is often caused either by a direct impact to the shoulder or by a fall onto the scapula. However up to six grades of separation have been described with types I – III as above; type IV having a posterior dislocation of the clavicle; type V with an inferior displacement of the scapula (i.e. like type III but clavicle stays in situ)

and type VI where the clavicle is driven inferiorly into a subacromial or subcoracoid position (Williams, Nygeun & Rockwood 1989)

Ac joint sprain is generally caused by a direct impact onto the point of the shoulder (Rockwood & Green, 1996) and (Fukuda et al, 1986) showed the most frequent pathological displacements of the clavicle clinically are superior and posterior.

Acromio-clavicular joint injuries make up 12% of shoulder dislocations (Cave, 1961) and 20% of all shoulder injuries will involve this joint (Kocher et al; 1998). It is reported that 45% of ice hockey players in the USA will have had an ac joint injury (Norfray et al; 1997)

Anecdotal separation of the ac joint is a common site of injury in many martial arts, usually as the result of the participant being thrown to the floor during either training or competition and around 6% of all martial arts injuries involve the shoulder joint (Ashby & Corbo: 2001) a figure which supports earlier studies by (Birrner et al 1982) which suggested an overall rate of 7%, with 44% of all injuries in Judo involving the shoulder. This compares with other activities such as basketball, which show a 3% rate of shoulder injury (Apple et al. 1982) 5% in racket sports (Marone 1986) and 2.6% in dance (Klemp & Learmonth 1984).

Physiological considerations

Between 65 and 70% of the ligament's weight is water but once this is removed 70 – 80% of the structure is type I collagen, which is mainly responsible for its tensile strength (Birk & Mayne 1997; Linsenmayer et al 1993). Ligamentous structure is determined by the loads placed upon it as mechanical loading has been shown to regulate the gene expression of collagen in ligaments (Hsieh et al 2002) and so each ligaments composition is directly related to its mechanical properties.

Exercise increases both structural strength and stiffness by as much as 20% when compared to untrained individuals (Frank 1996) and there is evidence that ligaments become larger and stronger per unit area following exercise (Butler et al 1978; Kiiskinen 1977; Tipton et al 1975; Woo et al 1980). This would suggest that often quite large forces are needed in these individuals in order to cause a grade III injury.

Diagnosis

Patients will normally present with pain in the shoulder, eased by the arm being supported in adduction and medial rotation. They can usually locate the site of the injury exactly and will give a history of falling onto the shoulder, directly onto the acromion-clavicular joint or of a direct trauma to the point of the shoulder (Rollo et al, 2005) and diagnosis is confirmed by clinical examination (McRae 1995) and X-ray; although weighted views appear to be of little value (Yap et al. 1999). It is suggested that the preferred view is the so-call Zanca view (1971) where there is a 15° cephalic tilt which gives an unobstructed image of the ac joint.

Clinically the so-called "scarf test" (or cross-over impingement test) is positive for ac joint dysfunction when pain is felt on the superior surface of the acromion (Berg et al 1998, Calis et al 2000).

Conclusion

As can be seen above acromio-clavicular injuries are relatively common in most sports but particularly in sports where either falling and/or contact is a feature. Therefore it is important to exclude such injuries when considering other conditions around the shoulder such as soft tissue trauma, injuries to the glenoid labrum or rotator cuff tendon injuries.

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Case study. Rehabilitation of an Acromio-Clavicular Joint Injury.

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This article will consider the rehabilitation of a martial artist who has suffered a grade III separation of the right acromio-clavicular joint during training. The text will outline the anatomy of the joint, the mechanism of the injury, the healing process and its effect on the shoulder complex but the main area of discussion will be focused on the end stage of rehabilitation and the practitioners return to full training/competition.

Joint Anatomy/Mechanism of Injury

The acromio-clavicular (ac) joint is the junction between the acromion process of the scapula and the distal end of the clavicle. It is described as a plane synovial joint and is surrounded by the joint capsule and supported by the Acromioclavicular and Coracoclavicular ligaments, the latter ligament being divided laterally into the trapezoid portion and medially into the conoid portion (Gray's Anatomy; 1978).

The Acromioclavicular ligament reinforces the joint superiorly lying above the joint capsule with attachments at the distal end of the clavicle and the superior aspect of the acromion. The Coracoclavicular has two attachments on the inferior surface of the clavicle the distal one third of the inferior surface (the trapezoid portion) and the middle one third of the posterior surface (the conoid portion) both of which share an attachment on the supero-anterior surface of the coracoid process of scapula.

The shoulder joint is a loose ball and socket synovial joint and is mainly supported (as is the ac joint) by the muscles of the rotator cuff; subscapularis, supraspinatus, infraspinatus and teres minor and these muscles work together to form a cuff around the head of humerus and pull it into the glenoid fossa thus conferring dynamic stability onto the joint. (Whiting & Zernicke 1998).

Sprains of the ac joint are generally graded from I to III with III being a complete separation of the joint ligaments and superior displacement of the distal end of clavicle both clinically and radiographically (Peterson & Renstrom; 1986). A grade III strain is often referred to as a shoulder separation and is often caused either by a direct impact to the shoulder or by a fall onto the scapula. However up to six grades of separation have been described with types I – III as above; type IV having a posterior dislocation of the clavicle; type V with an inferior displacement of the scapula (i.e. like type III but clavicle stays in situ) and type VI where the clavicle is driven inferiorly into a subacromial or subcoracoid position (Williams, Nygeun & Rockwood 1989)

Ac joint sprain is generally caused by a direct impact onto the point of the shoulder (Rockwood & Green 1996).and (Fukuda et al, 1986) showed the most frequent pathological displacements of the clavicle clinically are superior and posterior. Anecdotally separation of the ac joint is a common site of injury in many martial arts, usually as the result of the participant being thrown to the floor during either training or competition and between 6% of all martial arts injuries involve the shoulder joint (Ashby & Corbo: 2001) a figure which supports earlier studies by (Birrer et al 1982) which suggested a rate of 7%, with 44% of all injuries in Judo involving the shoulder. This compares with other activities such as basketball, which show a 3% rate of shoulder injury (Apple et al. 1982) 5% in racket sports (Marone 1986) and 2.6% in dance (Klemp & Learmonth 1984).

AC joint separations are generally treated conservatively following research by (Imatani et al: 1975) and (Hawkins: 1980) which suggested no difference in outcome between surgical and non-surgical treatments. This was reinforced by (MacDonald: 1985) who found that function was superior in non-surgical patients one year post-injury and (Walsh: 1985) who showed patients who were treated surgically rated

their functional outcome below that of patients who had not had surgical intervention and this was supported by (MacDonald et al 1988) although (McFarland et al 1997) showed no statistical difference in outcomes between the two regimes.

However no matter what treatment is applied 69% of patients who suffer Grade III separations report residual problems (Cox: 1981) and so aggressive intensive rehabilitation is indicated in all such injuries (Cox: 1991). This finding however was contradicted by (Tibone et al 1992) who showed no difference in strength in injured and uninjured shoulders on isokinetic testing 2 years post-injury.

Physiological considerations

A grade III ac joint injury involves total separation of the Acromioclavicular and both the trapezoid and conoid portions of the Coracoclavicular ligaments, usually in the midsubstance of the ligament (Rockwood et al 1996).

Between 65 and 70% of the ligament's weight is water but once this is removed 70 – 80% of the structure is type I collagen, which is mainly responsible for its tensile strength (Birk & Mayne 1997; Linsenmayer et al 1993). Ligamentous structure is determined by the loads placed upon it as mechanical loading has been shown to regulate the gene expression of collagen in ligaments (Hsieh et al 2002) and so each ligaments composition is directly related to its mechanical properties.

Following injury immobilisation of the joint coupled with load deprivation causes rapid deterioration of the ligamentous tissue (Frank 1996; Butler et al 1978) along with a decrease in collagen mass (Ameil et al 1982) and stiffness (Noyes et al 1974).

Exercise increases both structural strength and stiffness by as much as 20% when compared to untrained individuals (Frank 1996) and there is evidence that ligaments become larger and stronger per unit area following exercise (Butler et al 1978; Kiiskinen 1977; Tipton et al 1975; Woo et al 1980).

However these properties may take up to 12 months to reach their pre-injury integrity (Savio 2004) and so during this period the joint must be supported actively by the action of the surrounding muscles; in this case the rotator cuff.

Injury management rationale

Ac joint dislocation was recognised as early as 400BC by Hippocrates (Adams 1886) who recommended treatment with a compressive bandage and this approach is still adopted today. (Lemos 1998) suggest a four-week period of relative immobilisation in a sling immediately following injury followed by mobilization and strengthening over the subsequent three months and full participation in sports between three to five months post-injury. This paper will consider the regime in Appendix 1, which was applied to 25 year old Aikido practitioner who had suffered a grade III ac joint separation following a fall onto the point of the shoulder during a practise session as illustrated below (Figure 1)



Figure 1: Shihonage; a basic Aikido technique.

Aikido is non-competitive martial art, which is characterised by a large amount of falling and rolling (Ueshiba 2002) and so carries similar risks to the ac joint as other such arts as for example Judo.

Initially the injury was treated with ice, a compressive bandage applied for two weeks and the arm was immobilised for this time in a sling; being removed 2-3 times daily and moved passively through its pain-free range. This range was gradually increased and the sling removed after two weeks by which time the patient had begun active movements of the limb; initially supported by the other arm or on a sliding board again through pain-free range. Full range was achieved by six weeks although the patient still had residual pain at end of range in all movements.

The patient was keen to return to training and so this level of pain was deemed acceptable in this case and a full strengthening regime was undertaken in order to restore full function of the rotator cuff. Support from the rotator cuff is vital in this instance as ligament tissue may take up to one year to remodel effectively following immobilisation (Savio 2004) and so the effective tensile strength of the tissue is decreased during this period.

Since Aikido is a "whole body" activity it was decided to adopt a kinetic chain approach to rehabilitation of the shoulder complex as described by (McMullen & Uhl 2000) rather than isolated exercises for the rotator cuff. Additional isokinetic training of the internal and external rotators of the shoulder was also undertaken using measurement taken from the uninjured shoulder as target values in order to confer local stability to the shoulder joint.

Kinetic chain rehabilitation is based on biomechanical studies which show that proximal body segments accelerate the whole system and sequentially transfer momentum to the distal segment (Putnam 1993) and so lower limb and trunk segments are activated prior to upper limb motion occurring (Cordo 1982; Zattara 1988). In addition lower limb and trunk muscles act as synergists during the upper extremity motion (Cordo 1982; Zattara: 1988; Bouisset 1981). Therefore whole body movements are used to improve both the stability of the joint and the quality of movement can be achieved earlier than would be possible with an isolated treatment regime.

End stage rehabilitation regime

By the end of week 6 post-injury the patient reported minimal pain in

the shoulder at rest but that the joint felt weak and painful on movement, particularly at end of range and at speed.

Arm movements in Aikido occur in three planes: the vertical plane (a Schomenuchi attack), the horizontal lateral plane (a Yokomenuchi attack) and the horizontal frontal plane (a Tsuki attack) (Ueshiba 2002) all of which are performed rapidly with force. (Figure 2)

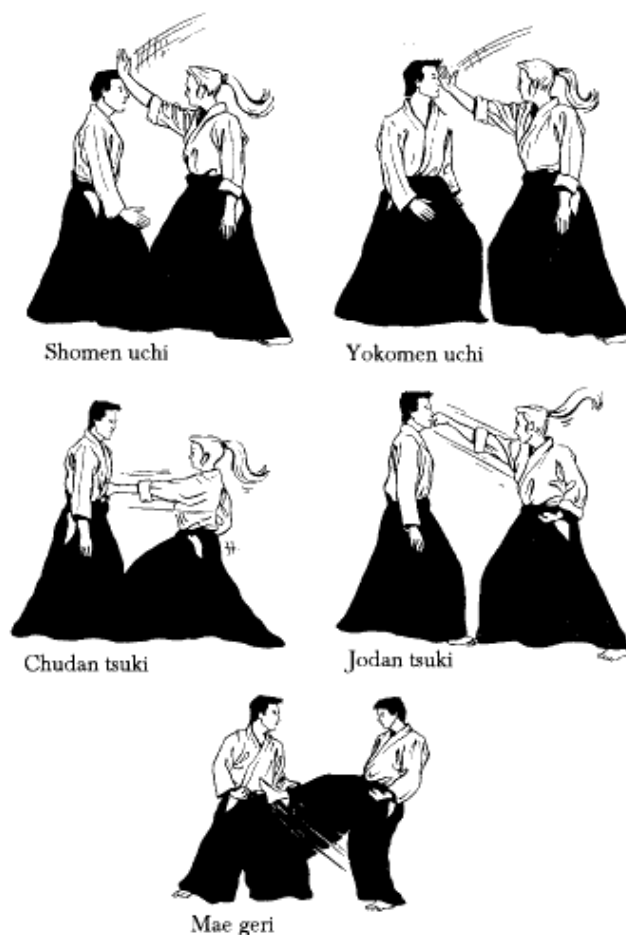


Figure 2: basic Aikido attacks.

Therefore the Aikidoist requires the following shoulder girdle actions all of which will load the ac joint;

1. Elevation through flexion, followed by extension with the forearm held in the neutral position.
2. Abduction with external rotation and scapular retraction, followed by horizontal flexion with external rotation and scapular protraction.
3. Flexion with scapular protraction and internal rotation of the shoulder.
4. All strikes are accompanied by a forward stride of the trailing leg

In addition to these basic simple movements contact; in the form of grappling; also requires multi-directional stability of the joint with rapid activation of the rotator cuff muscles.

Adopting the kinetic chain approach the following movement patterns were introduced in order to relate to the three basic strikes described above. The exercises were progressed from non-resisted to full resistance.

Vertical plane motion

Full arm elevation requires: full scapular retraction, and this in turn requires spinal extension and hip extension. (Putnam, 1993; Zattara & Bouisset, 1988; Knott & Voss 1968). Thus the large postural muscles of the trunk and pelvis position and stabilize the thoracic spine in order to allow the appropriate scapular motion. Also the ipsilateral hip extensors are activated prior to deltoid activation during forward arm elevation (Zattara & Bouisset 1988).

In order to promote this pattern of activation and so enhance stability the role of the hip extensors was exaggerated by introducing an ipsilateral step-up during the elevation phase. Also the patient was told to "get tall" in order to promote/encourage thoracic extension; which is necessary to achieve full arm elevation (Knott & Voss 1968; Kapandji 1982).

Once this action could be achieved smoothly resistance was added initially to the hip extension by attaching the patient to wall bars via looped Theraband to the ankle as such resistance may well stimulate both synergistic muscles and activate deficient shoulder flexors (Knott & Voss 1968; Sherrington 1906). This was further developed over a period of two weeks by the therapist de-stabilising the patient by looping Theraband around the pelvis and applying resistance at various angles during the stepping phase of the motion. The "striking" arm was also resisted in the same way in order to develop stability and control of the rotator cuff specifically as the Schomenuchi strike has to be delivered in as near perfect vertical motion as possible.

The final stage of the rehabilitation of this vertical movement involved using a weight in the hand during a motion performed at normal speed. In order to maintain relevance (and therefore motivation) for the patient a Bokken (a wooden practice sword of approx. 800 grams weight and 900cms length) was used in this stage of the rehabilitation as this is regularly used in Aikido practice (Figure 3).



Figure 3

Horizontal plane motion

As previously discussed horizontal motion occurs in two directions in Aikido, the lateral plane where the arm crosses the body (the Yokomenuchi strike) and the forward plane where the arm extends in front of the body (the Tsuki strike or thrust). In both cases the scapula moves from full retraction to full protraction and both strikes are accompanied by a forward stride. This means that rehabilitation of the proximal segments involved in both movements can be shared and this can be best be realised through a modification of the "shoulder dump" exercise described by (McMullen & Uhl 2000) thus:

"To attain right shoulder external rotation and scapular retraction, the athlete assumes a left-foot-forward stance and begins with the left hip flexed, trunk flexed and rotated to the left and right arm at knee level. The athlete then shifts weight to the rear foot while extending and rotating the trunk to the right. Active retraction of the right scapula and external rotation of the right arm coincides with this weight shift and trunk extension. The action simulates dumping a container backward. The degree of arm elevation or the height at which the imaginary container is dumped, depends on the level of recovery and functional ability"

In his particular patient the sequence should be reversed as the ending position of the "shoulder dump" is the starting position for both strikes. As the patient progresses resistance in the form of Theraband can be added, initially to the trunk in order to encourage proximal muscle activation as described above, and then to the "striking" arm as in the Schomenuchi strike rehabilitation sequence described above. Once this movement is achieved smoothly against resistance then dif-

ferentiation should be implemented, as at this stage proximal stabilisation is sufficient to provide a stable platform for a variety of movements.

In order to promote the Yokomenuchi or lateral strike the patient should perform a movement which combines the following elements: horizontal flexion, adduction and internal rotation of the shoulder combined with supination of the forearm; whilst stepping forward with the ipsilateral leg. This combination movement can be resisted by Theraband looped around the hand or wrist or by a dumbbell held in the "striking" hand. Once again as with the Schomenuchi strike a Bokken (Figure 3) can be used as this mimics the activity almost precisely whilst developing rotator cuff stability. In addition the forward stride can be resisted by Theraband, in order to promote initiation of the proximal musculature.

The Tsuki strike or thrust is initiated by the forward stride of the ipsilateral foot with the end phase of the movement being forward flexion of the shoulder, extension of the elbow and pronation of the forearm. Once again this movement can be resisted at hand and ankle by Theraband or by use of a dumbbell in the "striking" hand. In this instance final movement rehabilitation with the Bokken is again appropriate as it can be used in a fencing lunge type movement during Aikido sessions.

Strengthening of the rotator cuff

As mentioned previously it is important that the rotator cuff muscles should be compared with the uninjured side, preferably using an isokinetic dynamometer such as the Kincom which has been shown to have error values of less than 3.2% for force and 1.5% for speed across a range of measurements (Farrell & Richards 1986) and researchers have found isokinetic testing to be both a reliable and valid method of objectively measuring muscle function (Caiozzo et al 1981; Lesmes et al 1978; Moffroid et al 1969; Sherman et al 1981; Vitti 1984). Therefore a programme of sub-maximal isokinetic training should be initiated as soon as possible to minimize disuse atrophy of the shoulders muscle tissue particularly in the rotator cuff since vertical abduction strength of Grade III injuries may be reduced by up to 19.8% and horizontal abduction by as much as 24.3% in grade II injuries (Walsh et al 1985). Since the function of the rotator cuff is primarily to aid stabilization of the gleno-humeral joint functional strengthening exercises should also be performed as soon as weight-bearing is possible, in addition exercises should progress from closed kinetic chain to open kinetic chain exercises in order to load distal segments of the limb (McMullen & Uhl 2000) and so forcing the rotator cuff to control more of the arm's weight (Fujisawa et al. 1998). Progression may be from stabilization of the arm against a wall in standing to ball stabilization exercises such as offset press-ups. These are press-ups performed with the affected arm being supported on a medicine ball or for example a basketball and in order for the athlete to perform a press-up the ball is stabilised by the action of the rotator cuff (Chu 1998).

Conclusion

It can be seen from the above discussion that the priorities for this patient were;

- Early return to training
- Restoration of full function
- Prevention of recurrence.

By following the above kinetic chain regime these objectives will have been fulfilled and due to the greater concentration on the function of the proximal segments i.e. trunk and lower limb there may even be performance gains.

In this instance the athlete returned to training after 6 weeks and was able to participate fully 12 weeks post-injury.

One further consideration in this instance is a re-examination of Ukeme or falling/receiving techniques by both the Aikidoist himself and his coach in order to prevent a similar impact in future.

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Images

Figure 1: http://www.takemusai-aikido.org.za/images/pck_shihonage.jpg

Figure 2: www.dokiai.com/images/techniques/attacl.gif

Figure 3: <http://www.kingfisherwoodworks.com/>

An analysis of physiotherapist assessed "medical-attention" injuries in inter-county Gaelic footballers: a 6-year case study.

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Abstract:

The purpose of this study was to analyse the type of "medical-attention" injuries an inter-county Gaelic Football physiotherapist would be required to treat over the course of many seasons. The study design took the form of a prospective analysis of injuries sustained in an inter-county squad of Gaelic footballers over the period of 2001 to 2006. The sample of players consisted of 48 inter-county footballers aged between 18 and 29 years of age. Injuries sustained during inter-county Gaelic Football competition or training, which were treated, diagnosed, and recorded by the clubs chartered physiotherapist were reported in this study. The physiotherapists' injury records revealed a total of 115 injuries sustained by 48 players over six seasons (1.6 injuries per month). Muscle strains (19.1%), bruise/contusions (18.3%), facet joint dysfunction (15.7%), and sprains (12.2%) were among the most common type of injuries. The hamstring was the most frequently injured site (25.2%), followed by the back (17.4%), ankle (11.3%), and groin (10.4%). Soft tissue injuries accounted for 82.6 % of all injuries sustained. Over the 6 seasons, January (14%), March (16.5%), and November (14.8%) were the months with the greatest injury frequency. The findings of this study provide an insight into the amount and type of injuries that physiotherapists typically treat when working with inter-county Gaelic football squads, and thus allow physiotherapists to better prepare for this role. Future studies should assess injury data from multiple inter-county squads over a number of seasons.

Introduction:

Gaelic football is one of the national sports of Ireland (McIntyre, 2005). It is a field game consisting of two teams of 15 players who compete for 70 min duration, where each team is comprised of a goalkeeper, 6 defenders, 2 midfielders, and 6 forwards (McIntyre and Hall, 2005). A point is scored when the ball passes over the bar and between two goal-posts, a goal is worth 3 points, and is scored when the ball crosses the goal-line beneath the cross-bar. The main skills of the Gaelic football include high catching, long distance kicking, passing the ball quickly and accurately by hand or foot, side-stepping opponent whilst in possession of the ball, solo-running by kicking the ball to oneself and collecting it before it bounces, and blocking an opponent's kick or hand-pass (Strudwick et al., 2002). In addition to this, players tackle opponents for possession of the ball by either shoulder barging, or by knocking the ball out of the opponents grasp (Crowell et al., 2000).

Senior Gaelic football is competed at club and inter-county levels. All players play with their local clubs within a particular county. From these clubs, about 28-30 of the best players are selected to train and play with their county. The players who are chosen for their respective county teams are regarded as the best or the elite in that particular county (Cromwell et al., 2000). There are 32 counties in Ireland, and each county plays in their particular provincial championships from the beginning of May. If successful, teams progress to play in the All-Ireland series with the ultimate goal of being crowned All-Ireland champions in late September. Preceding this championship, counties are involved in a league competition from January until April, but the main focus is the upcoming provincial knockout series (Cromwell et al., 2000).

Contemporary Inter-county Gaelic footballers engage in rigorous and systematic training during the competitive season despite the sports amateur status (Reilly & Doran, 2000). This rigorous training schedule combined with the speed at which Gaelic football is played, and the

amount of physical contact, acceleration, deceleration, and turning involved in match play, is likely to result in a significant rate of injury (Wilson et al., 2007). However, despite this risk of injury and its growing popularity, Gaelic football has received relatively little attention in the sports science literature.

Studies examining injuries in Gaelic football have presented injury information from accident and emergency departments (Cuddihy & Hurley, 1990; Murphy et al., 1992; Carroll et al., 1995), questionnaires requiring players to recall injuries over a period of time (Cromwell et al., 2000), and from monthly interviews asking players about their injury experiences over the duration of the study (Wilson et al., 2007). Injury information reported from accident and emergency departments tend to be biased towards the more serious types of injury and those requiring surgery, and therefore, may miss injuries of a less severe nature (Cromwell et al., 2000). Whereas, studies requiring participants to recollect injuries sustained over a length of time can be limited by the participants' ability to recall injury information accurately and completely (Burke et al., 2005). In addition to this, some of the injuries reported in these studies may not have been diagnosed by a medical professional. Furthermore, because questionnaires can be time consuming, players who sustain multiple injuries may be discouraged from providing information on all injuries sustained (Cromwell et al., 2000).

Cromwell et al. (2000) analysed injury data obtained from questionnaires completed by 6 elite Gaelic football teams over a six month period. A total of 88 injuries were reported within a group of 107 players over the duration of the study. The lower extremity provided the majority of injuries accounting for 77% of all injuries. The most common injury sites recorded in this study was the ankle (21%), followed by the hamstring (13%) and the knee (13%). Soft tissue injuries accounted for 84.5% of injuries, as shown by injuries to the muscle (33%), ligament (32%) and tendon (16%). The months found to have the highest incidence of injury was June (28%) and April (19%).

In another study, Wilson and colleagues (2007) gathered information regarding the injury experiences of 83 Gaelic footballers from three counties, by interviewing the players each month during the 6 months of the playing season. Of the 90 injuries recorded over the study duration, bruise/contusions were reported as the most common type of injury (28%), followed by muscle strain (23%) and ligament sprain (18%). The ankle was found to be the most common injury site (13%), whilst a slightly lower incidence of injury was noted for the hamstrings (12%) and quadriceps (12%). Tackling accounted for 27.8% of the injuries sustained, while sprinting and turning was responsible for 14.4% and 13.3%, respectively.

Wilson and colleagues (2007) found that considerably more Gaelic football injuries were treated by physiotherapists than by any other health professional. Therefore, the purpose of this study was to present an overview of the type of injury that a physiotherapist of an inter-county Gaelic Football squad would be required to treat. In addition to this, the study provides insight regarding the type of "medical-attention" injuries inter-county Gaelic footballers sustain over the course of many seasons.

Methodology:

The study design took the form of a prospective analysis of injuries sustained in an inter-county squad of Gaelic footballers over a 6-year period. Data was obtained from player-physiotherapist injury notes. Institutional ethical approval was sought and received before the com-

mencement of this study. A consent form was signed assuring anonymity and confidentiality of the material used for this study. Players were assured that the information collected would only be used for the purposes of data analysis and no reference would be made to the individual players.

Subjects:

The sample group examined in this study were male, elite, inter-county level Gaelic footballers. From the period of 2001 to 2006, 48 players from this inter-county squad received at least one treatment by the qualified team physiotherapist. Players contained in the injury notes were aged between 18 and 29 years of age.

Procedure

Each injury was diagnosed by the teams' chartered physiotherapist. The physiotherapist recorded the injury data in a specific injury log book. The injury information was then extracted from the physiotherapy injury notes, and narrowed down to the site of injury, type of injury, structure injured, time of injury (both month and year), and recurrent injuries.

Injury definition

For the purpose of this study, a "medical-attention" injury was defined as an injury resulting in a player receiving medical attention (Fuller et al., 2006). Only injuries sustained during Gaelic Football competition or training, which were treated and diagnosed by the clubs chartered physiotherapist were reported in this study.

Data Analysis

The data collected from the player-physiotherapy injury notes were analysed by separating the total number of injuries into different sections. The sections included the location of the injury, type of injury, number of injuries to specific structures, month and year the injury was sustained, and recurrent injuries. For the purpose of data analysis, each player was assigned a unique code number so that their identity was protected.

Results:

The physiotherapists' injury log book revealed a total of 115 injuries sustained by 48 players over the six seasons.

Site of injury

The hamstring muscle group was the site with the highest injury incidence (25.2%, 29 out of 115 injuries) followed by the back (17.4%, 20 out of 115) and ankle (11.3%, 13 out of 115). The groin accounted for 10.4% of all injuries (12 out of 115), while the shoulder and quadriceps both had a slightly lower injury incidence of 8.7% (10 out of 115). The knee accounted for 7% of total injuries (both 8 out of 115), followed by injuries to the hip (3.5%, 4 out of 115), foot (2.6%, 3 out of 115), and calf (2.6%, 3 out of 115) incidence of injury (both 3 out of 115). Injuries to the hand, elbow, and shin region had the lowest incidences of injury of 0.9% each (1 out of 115 each).

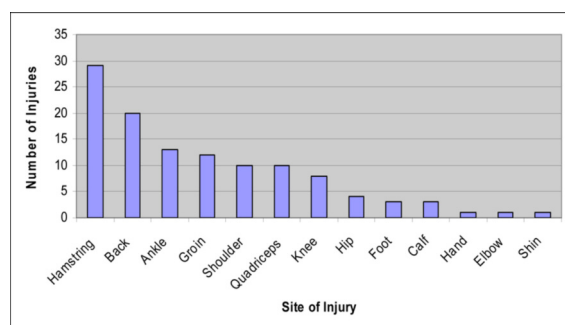


Figure 1: Site of Injury

Type of injury

Strains were the most common type of injury, and were responsible for 19.1% of total injuries (29 out of 115). Bruise/contusions had the second highest injury incidence with 18.3% (21 out of 115). Facet joint dysfunction was responsible for 15.7% of all injuries (18 out of 115), followed by muscle tightness (14%, 16 out of 115), sprains (12.2%, 14 out of 115) and pain (6%, 7 out of 115). Tendonitis accounted for 4.3% of all injuries (5 out of 115), meniscal tears and dislocation injuries both had an injury incidence of 1.7% (2 out of 115), while only 1 subluxation injury (0.8%) was reported.

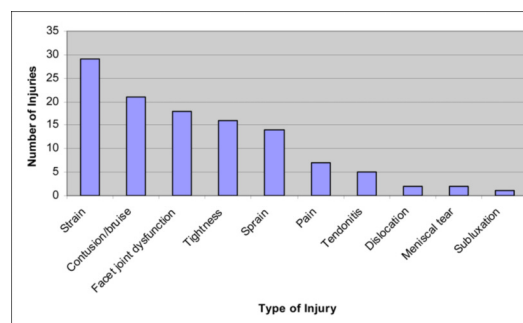


Figure 2: Type of Injury

Injured structures

Injuries to the musculotendinous unit were responsible for 67.8% of total injuries (78 out of 115). Muscle was the most frequently injured individual structure, accounting for 63.4% of total injuries (73 out of 115). Facet joints were the next highest injured structure at 15.7% (18 out of 115), followed closely by injuries to ligaments (14.8%, 17 out of 115). Tendon injuries had a low injury incidence of 4.3% (5 out of 115), while meniscal injuries were found to be the least frequent at 1.7% of total injuries (2 out of 115).

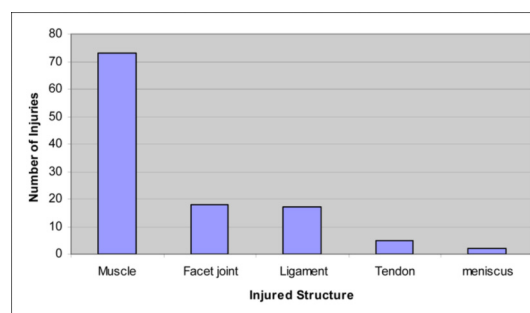


Figure 3: Injured Structures

Month of injury

Over the six season duration of the case study, the most amount of injuries occurred in the month of March (16.5%, 19 out of 115). This was followed by the months of November and January, which had an injury incidence of 14.8% (17 out of 115) and 14% (16 out of 115) of all injuries, respectively. While, February, April, May, and June accounted for 7.8% (9 out of 115), 12.2% (14 out of 115), 8.7% (10 out of 115), 10.4% (12 out of 115), respectively. The lowest months in terms of injury incidence were July, August, September, and December, which recorded 5.2% (6 out of 115), 1.7% (2 out of 115), 3.5% (4 out of 115), 5.2% (6 out of 115), respectively. No injuries were recorded for October.

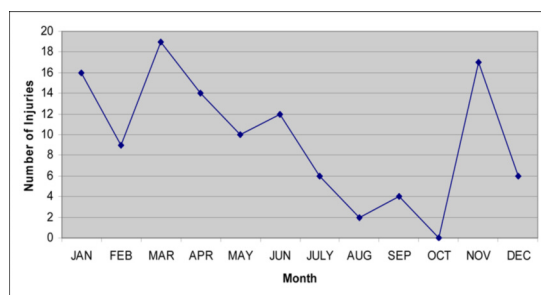


Figure 5: Month of Injury

Season of injury

The season of 2004 was found to have the highest injury incidence, with 28.7% of all injuries occurring during that season (33 out of 115). The next highest incidence of injury occurred in the 2002 season with 18.3% of total injuries (21 out of 115), closely followed by 2003 (17.4%, 20 out of 115). The seasons of 2005 accounted for 14.8% of all injuries (17 out of 115), while 2001 and 2006 both had an incidence of 10.4% (12 out of 115).

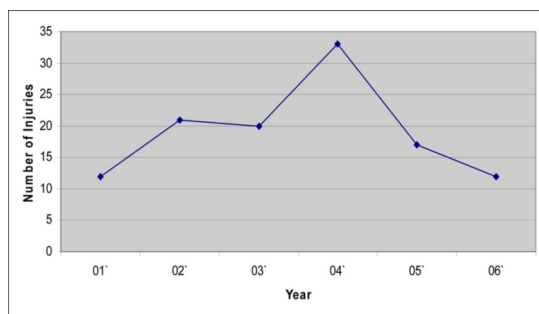


Figure 4: Season of Injury

Recurrent Injuries

The recurrent injuries amounted to a total of 20 injuries. Of these, facet joint injuries accounted for 14 incidences in just 2 players; one player had 9 reoccurrences of this injury, while the other had 5. One player had 3 recurrent groin strains, while another had 3 reoccurrences of a hamstring strain.

Table 1: Recurrent Injuries

Type of Injury	Number of Occurrences	Number of Players
Facet Joints Dysfunction	14	2
Groin Strain	3	1
Hamstring Strain	3	1

Discussion:

Analysis of the inter-county team physiotherapist injury log book revealed a total of 115 injuries sustained by 48 players over a 72-month period. This meant that the physiotherapist in this case only dealt with an average of 1.6 injuries per month. This rate of injury is low compared to other Gaelic football injury studies. Wilson et al. (2007) reported a total rate of 90 injuries over 6 months (15 injuries per month), while Cromwell and colleagues (2000) recorded 88 injuries over a 6 month period (14.6 injuries per month). However, the sample size of both studies was significantly larger than the current study. Wilson et al. (2007) investigated injury information taken from a total of 83 players representing 7 senior club teams, whereas Cromwell et al. (2000)

compiled injury data from 107 players playing for 6 inter-county teams. That said, due to the longitudinal nature of the current study, a larger injury incidence might have been expected, regardless of sample size.

Alternative reasons for the discrepancy between the current study's injury rate and previous findings may be found in the methodological differences between the studies. In the current study the same physiotherapist diagnosed and recorded each injury. Previous studies have used monthly interviews and questionnaires to record injury data, thus, the information gathered may have come from a number of different sources (Cromwell et al., 2000; Wilson et al., 2007). Therefore, it is possible that the number of injuries that the individual medical professionals actually treated may have been similar to the current study. In addition, to this it may have been the case in previous studies that some injuries may not have been diagnosed by a qualified medical professional, which may have influenced their results.

In the current study, the hamstring muscle group had the site with the highest injury incidence (25.2%) followed by the back (17.4%), ankle (11.3%), and groin (10.4%). Although, higher incidences of hamstring injuries were found compared to previous Gaelic football injury studies, these studies did nonetheless, report high amounts of hamstring injuries. In Cromwell et al. (2000) hamstring injuries accounted for 13% of total injuries, which was similar to the 12% reported by Wilson and colleagues (2007). Both Cromwell et al. (2000) and Wilson et al. (2007) found the ankle to be the most commonly injured site (21% and 13%, respectively). The ankle in the current study had an incidence of 11.3%, which was only slightly lower to that found in Wilson et al. (2007).

In the present study, the incidence of groin and quadriceps injuries (10.4% and 10%, respectively) was consistent with the 9% and 12% reported in Wilson et al. (2007), whereas, the amount of shoulder injuries was slightly lower to Cromwell and colleagues findings (8.7% vs. 12%). The probable explanation for the large incidence of lower limb injuries in Gaelic football may be the high amount of running, jumping, kicking, swerving, turning, and side stepping involved in the game, whereas, the shoulder injuries may have been as a result of shoulder-to-shoulder charging when competing for possession of the ball. The least injured sites were that of the hand, elbow, and shin region had the lowest incidences of injury of 0.9% each. The figure for hand injuries is surprisingly low considering the extent of hand contact with both the ball and opponents, but is comparable to previous findings (Cromwell et al. 2000; Wilson et al. 2007).

The only clear discrepancy between the findings of the present study and previous findings in terms of injured sites can be seen in the incidences of back injuries. In this current study back injuries accounted for 20% of all injuries, compared to incidences of 7% and 2% reported in Cromwell et al. (2000) and Wilson et al. (2007), respectively. This disparity can be explained by considering the recurrent injury data. Injury to the facet joints accounted for 15.7% of the back injuries recorded. However, only two of the 48 player sample suffered facet joint injuries, but these two players had 14 reoccurrences of this injury. Taking this into account, the reoccurrence of facet joint injuries within a couple of players, most likely led to an inflated incidence of back injuries in the current study.

Similarly high incidences of muscle strains were reported in the present study (19.1%) compared to the 23.3% incidence found by Wilson and colleagues (2007). The same authors recorded bruise/contusions as the most common type of injury (28%), which was greater than the 18.3% observed in the current study. This high incidence of bruise/contusions is indicative of the physical nature of Gaelic football, where shoulder-to-shoulder charging and collisions are common place (Cromwell et al., 2000; Reilly & Doran, 2001).

Facet joint dysfunction was responsible for 15.7% of all injuries in this present study, followed by muscle tightness (14%), sprains (12.2%),

and pain (6%). Both Cromwell and colleague (2000) and Wilson et al. (2007) reported a higher frequency of sprains (17.8% and 33%, respectively). Cromwell et al. (2000) reported a 33% incidence of muscle injuries, but unfortunately, the authors did not distinguish between muscle strains and tightness, whereas, Wilson et al. (2007) noted an injury frequency of just 3% for muscle tightness. Disparities between reported muscle tightness incidences could be due to differences in the diagnosis of strains and tightness in the previous studies, where some muscle tightness cases may have been inaccurately recorded as strains. In the current study, diagnosis was made by one physiotherapist, while other studies used a variety of medical professionals. A high frequency of sprains and strains in Gaelic footballers is not surprising, considering that Cromwell et al. (2000) attributed 22% of injuries to collisions, and 19% of injuries to twist/turn actions, while Wilson et al. (2007) reported that tackling and turning accounted for 27.8% and 13.3% of all injuries, respectively. The types of injury with the lowest incidence were those of a more severe nature, such as subluxation (0.8%) and dislocation (1.7%) injuries.

In the present study, soft tissue injuries accounted for 82.6 % of injuries sustained, as shown by injuries to the muscle (63.4%), ligament (14.8%) and tendon (4.3%). This figure is in agreement with the soft tissue injury incidence of 84.5% reported by Cromwell et al. (2000). In addition to this, when discounting the high amount of facet joint injuries (15.7%), muscles and ligaments were the most frequently injured structures in the present study. This finding was similar to Wilson et al. (2007), who noted a 54.1% incidence of muscle injuries (bruise/contusions, strains, and tightness combined) and 17.8% frequency of ligaments.

Over the six season duration of the case study, the most amount of injuries occurred in the month of March (16.5%), followed by the months of November and January (14.8% and 14%, respectively). This was in contrast to Cromwell et al. (2000) who reported that the months with the highest incidence of injury was June (28.3%) and April (19%), which in the present study accounted for 10.4% and 12.2%, respectively. Cromwell et al. (2000) noted that 82% of subjects reported injuries in the period January to June, while in the current study 69.5% of injuries occurred during the same period. Discrepancies between the monthly injury incidences may be due to the differences between the duration of studies. Cromwell and colleagues (2000) investigated injury data over one 6 month season, whereas the current study analyses injury over 6 years.

The season of 2004 was found to have the highest injury incidence (28.7%), followed by the 2002, 2003, and 2005 seasons with 18.3%, 17.4%, and 14.8% of total injuries, respectively. The reason for the high injury incidence in 2004 may have been as a result of the greater amount of games played that season compared to other seasons. The team was required to play more games this year because two of their championship games required replays. Each replayed game was played within 5 days of the original game. Thus, taking into account the intensity of championship games and the reduced physiological recovery time in between matches, players may have been at a higher risk of injury (Woods et al., 2002). To this researcher's knowledge, this study is the first to look at Gaelic football injuries over a number of seasons, due to this there is unfortunately no comparison data available.

Admittedly, it is more than likely that the injuries reported in this case study does not include all the injuries sustained by the players during the study period. Less severe injuries that may not have required medical attention, injuries diagnosed and treated by other medical professionals, and injuries sustained by players while playing for their respective clubs would not have been recorded in this study. However, each injury included was diagnosed, treated, and recorded by the same chartered physiotherapist, thus ensuring the reliability of the data collected. Furthermore, the information presented provides insight

regarding the type of injury that an inter-county physiotherapist would typically treat over the course of many seasons.

To provide a more comprehensive overview of Gaelic football-related physiotherapist-assessed injuries, a longitudinal study involving multiple teams is needed. Future injury analysis in Gaelic football would benefit from combining data collected from all medical professionals involved and from the players themselves, using standardised recording logs as used by Fuller et al. (2006). In addition to the information included in this study, data regarding the mechanism of injury, the side of the body which the injury is sustained, the training and match time lost as a result of each injury, and whether the injury occurred during training or match play, should also be included.

In conclusion, this case study reported that the inter-county physiotherapist treated a total of 115 injuries in 48 players over a 72-month period, which amounted to 1.6 injuries per month. Of these injuries, the muscle strains, facet joint dysfunction, bruise/contusions, and sprains were among the most common. The hamstring was the most frequently treated injury site, followed by the back, ankle, shoulder, and quadriceps. Over the 6 seasons studied January, March, and November were the months with the highest injury rates. The findings of this study can assist Gaelic football physiotherapists to better prepare for the type of injuries they will be required to treat, and thus, help to improve recovery from these injuries. Future studies should assess injury data from multiple inter-county squads over a number of seasons.

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Does Proprioceptive training help to reduce Anterior Cruciate Ligament Injuries; A review of the current evidence.

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Abstract

Proprioception has been shown to play a key role in rehabilitation (Lephart et al 1997) and specifically in rehabilitation of the ACL deficient knee (Cooper et al 2005, Andrews et al 1999, Beard et al 1994a). whilst several studies have documented a decreased proprioceptive ability in the ACL deficient limb (Barrett et al 1991, Corrigan et al 1992, Pap et al 1999, MacDonald et al 1996), and also decreased hamstring latency (Beard et al 1993, 1994a).

This article reviews the evidence that proprioception or balance training can prevent Anterior Cruciate Ligament (ACL) injuries in athletes without previous ACL injury using studies such as those of Peterson et al (2005) Hewett et al (1999) and others which report significantly lower incidence rates of ACL injury in athletes who were in an intervention group compared to a control group.

Many articles recommend a return to rigorous sporting activity following a minimum of six months (Eriksson et al 2001, Jansson et al 2003, Pinczewski et al 2002, Orchard et al 2002) whereas others recommend a return at nine months or later (Feller et al 2003, Corry et al 1999, Otto et al 1998) and this will also be discussed.

This article will discuss the concept of proprioceptive prehabilitation and whether this type of prevention training can prevent anterior cruciate ligament injuries (ACL) in athletes. The ACL ligament will be discussed in terms of structure, biomechanics, incidence of injury and the mechanics of injury. The term proprioception will also be examined and applied to ACL injury.

Proprioception

Proprioception can also be described as the detection or sensation of joint movement (kinaesthesia) and joint position (joint position sense) (Irrgang 1993, Lephart et al 1997). The sources of this proprioceptive information are mechanoreceptors in the joint capsule, ligaments, tendons and muscles (Johansson et al 1991 cited in Fonseca et al 2005). Several studies have measured proprioception by means of joint position sense (Carter et al 1997, Barrett 1991, Good et al 1999) and others have used passive movement detection (Beynonn et al 1999, MacDonald et al 1996). Others have measured proprioception using both measurement techniques (Fischer-Rasmussen et al 2000, Co et al 1993). Proprioceptive measurement could be implemented into screening programs for athletes, therefore highlighting individuals who may need specific proprioceptive training to help prevent injury.

Proprioception has been shown to play a key role in rehabilitation (Lephart et al 1997) and specifically in rehabilitation of the ACL deficient knee (Cooper et al 2005, Andrews et al 1999, Beard et al 1994a). As discussed before several studies have documented a decreased proprioceptive ability in the ACL deficient limb (Barrett et al 1991, Corrigan et al 1992, Pap et al 1999, MacDonald et al 1996), and also decreased hamstring latency (Beard et al 1993, 1994a).

This article attempts to evaluate the role of proprioceptive prehabilitation to reduce ACL injuries in subjects without previous history of injury to the ACL; and to assess the use of proprioceptive prehabilitation in preventing ACL injuries before a major proprioceptive deficit occurs, or in subjects without a history of ACL injury.

In other words, can proprioceptive training programme be implemented into a prehabilitation programme to decrease the risk of ACL injuries in athletes?

The Anterior Cruciate Ligament (ACL)

Proprioception and the Anterior Cruciate Ligament

Proprioception is found to be decreased following joint injuries such as ACL or meniscus tears, shoulder dislocation, ankle sprain and in joints with degenerative joint disease (Jerosch and Prymka 1996).

Since joint stabilising muscle activity is influenced by proprioception (Rozzi 1999b) this may be one reason for this increased risk of sustaining ACL injury.

Prevention of Anterior Cruciate Ligament injuries

In 1996, Caraffa et al published results of their study on the effect of proprioceptive training on the incidence of ACL injuries in football players.

"Their study was predicated on the concept that because proprioceptive training is essential to help prevent reinjury of athletes following injuries to the knee or ankle ligaments, prophylactic proprioceptive training should decrease the rate of initial ligament injury in these joints" (Mandelbaum 2001 p97).

The teams were followed for three seasons, in which 80 arthroscopically verified ACL injuries occurred, 10 of these occurred in the group who performed the proprioceptive balance training, and 70 ACL injuries were recorded in the control group. This breaks down to a rate of 0.15 ACL injuries per team per season in the trained group and 1.15 ACL injuries per team per season in the control group respectively. This is a hugely significant difference, the study found an 87% decrease in ACL injuries. Also adherence to the programme, and the actual incidence of ACL injuries was not monitored. Initially, the evidence from Caraffa et al's (1996) study to implement proprioceptive exercises into a training program looks positive. In contrast to Caraffa et al's (1996) impressive results, Sodermann et al's (2000) study 'Balance board training: prevention of traumatic injuries in the lower extremities in female soccer players' did not yield such remarkable results. Sodermann et al's study focussed on professional female soccer players from Sweden over one season. There were no significant differences between the two groups in traumatic injuries or ACL injuries. However, it must be noted there was one ACL injury in the control group and four ACL injuries in the intervention group, therefore the programme did not appear to be effective in reducing ACL injuries.

Neuromuscular training is more functional training that may alter active knee joint stabilisation (Hewett 2006) and works at the following three levels; spinal cord, brain stem and cerebral cortex.

The spinal cord level is responsible for reflex responses necessary for protective reflex joint stabilisation (Hewett et al 2002, Reimann et al 2002a, Biedert 2000, Rozzi et al 2000).

The brain stem processes sensory input involved with maintaining posture and balance (Hewett et al 2002, Reimann et al 2002a, Lephart et al 1997, Biedert 2000, Rozzi et al 2000), therefore enhancing motor function at this level requires the use of proprioceptive exercises or balance exercises.

The final level, the cerebral cortex is responsible for more complex and discrete voluntary movements (Hewett et al 2002, Reimann et al 2002a, Lephart et al 1997, Biedert 2000, Rozzi et al 2000).

Hewett et al (1999) produced the first prospective study to report the effects of neuromuscular training on knee injury in female athletes involved in high-risk sports, in this case soccer, volleyball and basketball.

Myklebust et al (2003) investigated the value of a proprioceptive and

neuromuscular training programme on the incidence of ACL injuries in female team handball players in the top three divisions in Norway over three seasons. During the control season there were 29 ACL injuries, in the first intervention season there were 23 ACL injuries and 17 ACL injuries during the second intervention season.

Peterson et al (2005) performed a study of injury prevention in German female team handball players over one season. The intervention programme was implemented into 10 teams (134 players) training routines, whilst the 10 remaining teams (142 players) followed their normal training programmes. There were 5 ACL injuries in the control group compared to 1 in the intervention group, therefore risk of sustaining an ACL injury in the intervention group was 80% lower, however this was said not to be significant. Also in 2005, Mandelbaum et al published the results of a controlled cohort study, which attempted to decrease the incidence of specifically non-contact ACL injuries in American female soccer players. The control group consisted of 1905 female soccer players from 95 teams. During the first season a total of 2 ACL injuries resulting from 34,476 athlete exposures in the intervention group were sustained. 35 ACL injuries were reported in the control group, this is an incidence rate of 0.51 incidences per 1000 athlete exposures. Heidt et al (2000) implemented a 7-week neuromuscular training intervention programme into the pre season training routines of 42 female soccer players, 258 other players acted as controls. The trained group had significantly fewer (14%) injuries overall than the untrained group (33.7%). 1 ACL injury was sustained in the intervention group and 8 were sustained in the control group. An ACL injury occurred in 2.4% of the intervention group and 3.1% of the control group.

Conclusion

Currently there is not enough evidence to prove proprioceptive prehabilitation alone can decrease the incidence of ACL injuries. Out of the two main studies that used only proprioceptive exercises, only Caraffa et al's 1996 study was successful in preventing ACL injuries in athletes without a previous history of ACL injury. Even the highly successful study by Caraffa et al (1996) is flawed by the use of proprioceptive neuromuscular facilitation simultaneously with proprioceptive exercises making it impossible to say which element of the training protocol reduced ACL injuries. Of the studies that used neuromuscular training combined with proprioceptive exercises only one (Mandelbaum et al 2005) found a statistically significant decrease in the rate of ACL injuries in the intervention group compared to the control group. Although Peterson et al (2005) and Myklebust et al (2003) did not find statistically significant results, they all found some degree of decrease in ACL injuries in the intervention group.

There is also evidence that neuromuscular training alone may help to prevent ACL injuries. Hewett et al (1999) report significantly lower incidence rates of ACL injury in athletes who were in the intervention group compared to the control group. Heidt et al's (2000) study did not find statistical significance, however the authors did find a decrease in ACL injuries in the intervention group when compared to the control group. Many articles recommend a return to rigorous sporting activity following a minimum of six months (Eriksson et al 2001, Jansson et al 2003, Pinczewski et al 2002, Orchard et al 2002) whereas others recommend a return at nine months or later (Feller et al 2003, Corry et al 1999, Otto et al 1998). Lattanzio et al (1997) conducted a study to investigate the effects of muscular fatigue on knee joint proprioception. Collagen is produced by fibroblasts (Tortora and Grabowski 2003) and forms the structure of the ACL (Duthon et al 2006, Frank 2004, Strocchi et al 1992). Moller-Nielson et al (1991) reported that female soccer players demonstrated higher incidences of injury during the luteal phase of the menstrual cycle, in this stage both oestrogen and progesterone concentrations are high (Slaughterbeck et al 2002, Indge et al 2000). In contrast to Slaughterbeck et al (2002) and Myklebust et al (2003), Wojtyś et al (1998) observed a trend towards rising ACL injuries during the ovulatory phase where oestrogen levels peak and a decrease in ACL injuries in the follicular phase of the cycle. As discussed previously

proprioception is most effectively enhanced through CKC exercise (Bunton et al 1993). It has also been identified that there is evidence to prove that neuromuscular exercises or in conjunction with proprioceptive exercises may prevent ACL injuries. The programme should include both proprioceptive exercises and neuromuscular exercises, therefore, helping to prevent the most prevalent injury in sport, the ankle sprain, and one of the most traumatic and debilitating injuries in sport the ACL injury.

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Discussion Paper.

To what extent does evidence-based practice assist practitioners to avoid confusing personal opinion with scientific evidence, or personal ignorance with genuine scientific uncertainty?

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Clinical experience alone is often considered sufficient to guide clinical decision making. By exploring the model of Evidence-Based Practice (EBP), it will be argued, that providing optimal patient care requires the need for evidence to assist and guide a health care practitioner. Although EBP practice is simplistic and has the theoretical support of practitioners (Jette 2003 et al.), it is not always so readily implemented within a practical setting. Instead a practitioner may opt to rely on clinical experience alone to guide clinical decisions.

This paper attempts to resolve the challenge of implementing EBP into a practical, clinical setting by exploring the known barriers to utilising evidence in practice. It will explore the complexity of incorporating the seemingly uncomplicated process of applying evidence into practice. An appreciation of industrial factors which have a bearing on the ability of practitioners to become EB practitioners will be considered. The process of implementing Evidence into a clinical setting will also be reviewed. Finally, factors which affect practitioners implement evidence on a day to day basis will be explored including how EBP is used to support clinical decision making.

Evidence Based Practice has been defined by Sackett et al (1996 pg 71) as "...the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients/clients". In addition, Haynes (2002) sees EBP as a process, beginning with clinical questioning, critique or appraisal of the evidence, application of the evidence, and finishing with an evaluation of the clinical outcomes. Both definitions suggest EBP is a method in which health care professionals formulate clinical decisions, based on the best scientific evidence available for individual patients. The Canadian health Service Research Foundation (CHSRF) (2004) adds that evidence based practitioners combine not only research evidence but also political and organisational evidence to arrive at clinical decisions.

Greenhalgh (1997 pg 2) offers a simple definition of EBP "Evidence based medicine requires you to read the right paper, at the right time and then alter your behaviour and the behaviour of others in light of what you have learnt". Interestingly, this definition adds a component of a health care professional seeking to find clarification or develop knowledge in an area which they may be limited. This definition suggests a practitioner has the ability to admit to one's own errors and oversights, and to critically assess prior work. This is crucial because knowing one's own limitations is the basis of EBP (Law and McDermid 2008)

Within these definitions, there has been no mention of the value of a health care professionals experience in the field to help guide decisions. O'Brien (2001) suggests that treatments which are not supported from sound research studies, and are inconsistent with biological and physiological mechanisms, are not provided to clients. This proposition is founded on ethical grounds, where there is an area of ambiguity the practitioner has an obligation in giving a patient the right information about a treatment or results of a diagnostic test. Clinical experience can not substantiate up to date clinical research.

Refuting these claims that clinical experience should have minimal weight in clinical decision-making, Sackett (1996) explains that EBP is part external evidence and part therapists experience. Sackett (1996) offers that EBP is a combination of factors which ultimately play a fun-

damental role in achieving one goal – the best possible advice and treatment for the patient which incorporates practitioner experience and patients' beliefs. Sackett's definition offers a wholesome multi-factorial approach to the ways in which a health care professional cares for the patient. It is for this reason this definition will be used throughout this paper.

The varied definitions and wording of EBP provide an insight to the health care industry which follows Sackett et al (1996) thoughts which acknowledge the industry as an imperfect science. Naylor (1995) for example, suggests that clinical medicine seems to consist of few things we know, a few things we think we know (but probably don't), and lots of things we don't know at all.

It is obvious from these authors that aspects of health care, such as manual therapy are not strictly evidenced-based in that practitioners are working in situations which do not always have clinical evidence to support the rationale of an intervention or diagnostic test. This is not a novel discovery amongst health care practitioners, as Rothstien (2000) indicates many clinicians make treatment decisions based on information learned when training or during a short course. What can be of concern is that in most instances, an intervention plan is initiated without knowledge of a patients' true diagnosis (Stratford 2001). Despite the apparent uncertainty, practitioners intervene with treatment which may or may not be deemed effective. In these instances evidence-based practice is needed to establish the most effective treatment and diagnostic test available.

Naylor (1995) argues that the clinical experience of a practitioner is a deciding factor when diagnostic tests are ambiguous. In support, Stratford (2001) maintains that a practitioner needs to draw on clinical experience to interpret conflicting diagnostic results. However, this argument challenges the practitioners ability to accurately diagnose the exact nature of a patients complaint. Although a practitioner may be able to effectively diagnose patients by these means, there is no scientific evidence to support the rationale for the diagnostic test used, and specifically the suitability of the intervention chosen (O'Brien 2001).

A practitioner can mistake personal opinion for evidence, especially if there has been minimal or no formal education of evidenced based practices. This idea that evidence is not high on the agenda of the health industry is supported by (Stratford 2001) who suggests that textbooks and continuing education courses traditionally focus on the technical skills associated with clinical diagnostic tests. Furthermore, teaching institutions themselves have been accused of providing assessments or treatments which have little scientific grounding (O'Brien 2001). Jette et al (2003) support these claims by suggesting that undergraduates are 70% less likely to be familiar with the processes involved in evidence based practices than postgraduates.

This however is not to suggest that a practitioner who enlists in educational and professional development is not attempting to develop and stay up-to-date with industrial guidelines and intervention protocols. One might need to look at the quality of Continual Professional Development (CPD). Belenger (1997) called for Canadian physiotherapists to be critical of continuing education courses and recommended a program which would incorporate evidence-based practice. It is interesting to note Jette et al (2003) found that EBP knowledge is more

readily embraced by newly qualified postgraduates than for professionals that have been practising in the industry for upto 15 years.

In light of the lack of evidence based education, practitioners may rely on guidelines from industry leaders to guide practice decisions (Oxman 1995). Oxman (1995) found that practitioners assume that needs for scientific validation are met through industry leaders. However, Naylor (1995) suggests clinical guidelines writers fall into the same trap, marshalling an expert consensus that fails to distinguish fact from fervour. Oxman (1995) supports this by suggesting that even though expert opinion may be important and useful, it often lags behind the evidence.

Overall, it has been shown that the health care industry is flawed in terms of developing evidence-based practitioners. Educational facilities seem to fall short in delivering quality evidenced-based techniques. In addition, industrial association may publish out of date guidelines. From this, it can be appreciated how a practitioner can mistake personal opinion with scientific certainty. There are however means for practitioners to develop evidence-based practice within a clinical setting.

To increase an awareness of implementing evidence-based practice, Sackett et al (2000) devised a systematic process to function within a clinical setting. This is in addition to the clinical skills a manual therapist is required to utilise every day, such as taking a history, carry out examinations, establish a diagnosis, and plan options for interventions, several authors (Herbert et al 2001, Guyatt et al, 2000) propose that a practitioner must have further skills to effectively provide patient care. The process involves, asking answerable questions, finding the best evidence with which to answer these questions, appraising the evidence, applying the evidence to clinical problems, and evaluating the effects of the intervention on individuals

The first phase of developing EBP starts with questioning. Herbert et al (2001) tells that the initial practice of evidence based practice commences with an acknowledgment of uncertainty. With uncertainty, inquiry follows. Clinical questions arise frequently in providing health care, and clear defined questions are important to ensure clear answers (Oxman 1995). Clinical questions are devised from the link between the patient, and a particular treatment or diagnostic test (Oxman 1995). Factors such as the population treated, as well as the context in which the treatment would be carried out, need to be established (Bennett and Bennett, 2001). Devising a PICO (Patient, Intervention, Comparison, Outcome) question is one way of refining a question and finding suitable evidence. To have any benefit on patient outcomes, a clear question much incorporate components which will direct the practitioner to positive search results (CEBM 2008).

A practitioner strives to explicitly identify knowledge gaps. This contrasts with some traditional models of clinical practice in which uncertainty is seen as a failing and good practitioners are thought to be those who always know what to do, not those who question what they do (Herbert et al 2001).

Having posed a pertinent, answerable clinical question, a practitioner proceeds to find the best available evidence to answer this question. Finding the best available evidence is the second component to developing evidence based practice. Oxman (1995) and The Centre For Evidence-Based Medicine (2008) suggest finding evidence can be done by utilising several sources. For example, secondary sources of data provide evidenced based information on how to provide most favorable patient care (CMA, 2008). Examples of such resources, taken from The centre for evidence Based Medicine (2008) website include: UK National Library for Health, National Institute of Clinical Excellence (NICE) and New Zealand Guidelines Group. Specific Evidence based journals and periodicals such as Bandolier, British Medical Journal, Journal of Evidence Based Medicine provide (Belsey and Snell, 2001) information for practitioners on clinical practice.

Systematic Reviews such as the Cochrane Library are also useful, in which people from different countries find, appraise, and review available evidence from randomised controlled trials (RCTs) (Belsey and Snell, 2001). Although measures such as asking a colleague or referring to a passage from an up-to-date text book may be efficient and make the most sense, Oxman (1995) suggests that these methods are as only as up to date as the most recent reference, which means they are least, partly out of date.

An important aspect of EBP is to critique the evidence for its validity or clinical usefulness (Benett and Bennett, 2001). There is an inverse relationship between the quality of a study and the confidence of a clinical decision (MacDermid 2008). The concept of ranking levels of evidence is based on the principle that certain study types have more rigour and higher quality study designs provide more confidence to associated clinical decision-making (MacDermid 2008, Belsey and Snell 2001). A summarised level of evidence is found in the table below. This table shows the descending order of evidence according to its credibility.

Levels of Evidence

Level	Example
1	Strong evidence from at least one systematic review of multiple well-designed randomised controlled trials.
2	Strong evidence from at least one properly designed randomised controlled trial of appropriate size
3	Evidence from well-designed trials such as non-randomised trials, cohort studies, time series or matched case-controlled studies.
4	Evidence from well-designed non-experimental studies from more than one centre or research group.
5	Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees.

(Adapted from Belsey and Snell 2001, Oxford Centre for Evidence-based Medicine 2001, Law and Mc Dermid 2008)

Ultimately once a search has been carried out, the practitioner needs to consider whether the evidence may enhance the quality of care to his or her patient, or hinder it. Factors such as cost and time of treatment, patients' beliefs and expectations may effectively guide a practitioner's decision-making (Law and McDermid 2008). The literature clearly endorses an evidence hierarchy, placing a practitioners experience towards the bottom of this. Based on this, it can be shown how EBP can increase a practitioner's confidence in clinical decision-making, thus reducing any conceptions of mixing personal opinion as scientific evidence.

Once the literature has been evaluated for its suitability, knowing how to use the literature is essential to ensure practitioners are providing best patient care (Oxman et al 1995). From an evidenced based perspective, deciding if the intervention or diagnostic tool will produce a desired outcome without unreasonable risk and at a reasonable cost is imperative (Carr 1994). This is somewhat different in traditional models of practice in which the priority may be given to clinical experience as a form of evidence. Traditionally, clinical research evidence is happened upon rather than strategically sought out, and appraisal of clinical research is superficial or does not occur at all (Herbert et al 2001). Experience is a form of evidence which can be associated with improving patients' health outcomes. However scientific evidence is needed to provide a more rounded approach to patient care.

A challenging component of evidence based medicine is to find a means to objectify and evaluate the effects of changing a behaviour based on evidence. Greenhalgh (1996) states that there is a methodological minefield to attempt to interpret the degree a patient has benefited from an evidenced based health care decision. However, Belsey and Snell (2001) offer a pertinent example where EBP has positively affected a population with the advent of perioperative prophylactic measures for patients at risk of Deep Vein Thrombosis

(DVT) post surgery, which prior to evidence was a major cause (2 patients per 1000 per year) of disability and death in the United Kingdom.

Measuring the efficacy of implementing an evidenced-based decision is multidimensional for both practitioner and patient. Scientific evidence however, often measures outcomes as a dichotomy: was this process evidence based or not? This may not give a true experiential account of the overall performance of the practitioner (Greenhalgh 1996).

It has been shown that the process of evidence-based practice is both simple in its rationale and complex in its application. The process of asking answerable questions to find the best evidence with which to answer these questions was offered. In addition, appraisal of evidence, its application and evaluation to clinical scenarios were also presented.

O'Brien (2001) considers EBP intuitively attractive as it conjures up images of effective and efficient care for clients and the utmost in professionalism in the practitioner. However a grandiose image is not without its perceived hurdles in obtaining. A study by Jette et al (2001) showed overwhelming support (85% of respondents, n=1000) for the need to increase the use of EBP. A further 90% of respondents claimed EBP in a necessity in a clinical environment (Jette et al 2001). With such liberal support for EBP, why are practitioners not actively participating in it? Authors such as Bennett et al (2003) and Law, Pollock and Stewart (2004) found there is a significant lack of implementation of EBP practice within a clinical setting.

Reasons why EBP was not implemented included difficulty in finding time to search for evidence and then appraise and implement it (Bennett et al 2003, Law et al 2004), limited quantity of evidence in specific clinical areas (Bennett et al, 2003), insufficient quality of evidence (Hebert et al 2001), lack of access to computers and journal articles needed to carry out evidence for practice (Bennett et al 2003, Curtin and Jaramazovic 2001), and research not providing certainty since findings cannot be applied to individual patients (Hebert et al 2001).

For each reason why EBP is not been implemented, various authors provide arguments to ensure ample solutions and measures are considered before not undertaking EBP. Some solutions include support from a manager (Curtin and Jaramazovic 2001), access to relevant resources (Curtin and Jaramazovic 2001), and personal factors such as self-motivation and personal interest (Curtin and Jaramazovic 2001). Post graduate education was linked to greater use of current research literature (Bennett et al 2003).

The use of EBP is imperative in delivering optimal care for the patient. This essay has reviewed the definition of EBP specific to a clinical health care delivery perspective. The model in which EBP has evolved was discussed to appreciate how the health care industry has developed with respect to providing patient care.

The process of applying EBP was exhibited, which shows both its complexity in its application and simplicity in concepts. It was shown that the use of a practitioners personal opinion, although very valuable in patient care, does not constitute scientific evidence. Finally the main factors which were found to impede the practical application of evidence were discussed. This paper showed how a practitioner, involved in Evidence-Based Practice avoids criticism and can overcome the pitfalls of personal ignorance.

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Book Reviews.

Atlas of Clinical Gross Anatomy

Authors: Kenneth Moses, John Banks, Pedro Nava, Darrell Petersen.

Publisher: Elsevier Mosby, 2005

ISBN: 0323037445

pp: 612

This is a large (A4 size), soft-back text book produced by a team of anatomy professors, and a medical photographer. It contains many anatomical drawing and photographs relating to the main areas of the body which is divided into four areas: head & neck, upper limb, trunk and lower limb.

The book opens with an introduction to anatomy giving basic anatomical terms and definitions and this is followed by the areas mentioned above, which in turn are subdivided into various sections.

Each section follows the same format, a brief written introduction followed by full page colour plates showing the surface anatomy, superficial, intermediate and deep dissection(s), osteology and radiology (inc. CT and MRI scans). The sections conclude with a table of the muscles listing their origins, insertions, actions, innervations and blood supply.

One drawback is the size of the book itself as it bulky and heavy to carry around and takes up a substantial amount of desk space during use. The book is also clearly laid out with excellent quality of photographs and clear easily legible text.

In addition the sections are clearly defined and described with a logical progression to the text, which is easy to understand. The level of knowledge is, however, somewhat basic for the serious student of anatomy.

When taken overall this work provides a useful resource to both students and clinicians alike and could be recommended for both groups.

Philip Smith April 2008

Anatomy and human movement structure and function 5th Ed.

Authors: Nigel Palastanga, Derek Field, Roger Soames

Publisher: Elsevier 2006

ISBN: 0750688149

pp: 715, paper back

This is an excellent anatomy textbook for sports therapy students and practitioners who need a thorough understanding of human movement. The authors of this text have been linked with physiotherapy and health science education programmes in the United Kingdom for many years.

This book begins with an introduction to anatomy and movement terminology, followed by an overview of the tissues involved in human movement. There is a chapter on the nervous system, the skin, and the components of the musculoskeletal system. The following chapters on the upper limb and the lower limb are comprehensive and well organised with an emphasis on joint movements. This layout assist in learning muscles, joint structures, and biomechanics involved in different movements.

There is a chapter which covers the trunk and the neck and is comprehensive and thorough for the movements in these areas. The final chapter, which covers the head and brain, provides a description of the muscles of facial expression and the muscles that move the mandible and hyoid bones.

The figures consist mainly of illustrations, with about 2 dozen radiographs and a handful of photographs. All are of excellent quality. The illustrations are clear, simple, and effective. The writing is consistent and clear, which is necessary when studying this topic. There are some descriptions of musculoskeletal injuries to contextualise learning into a clinical setting; however, no case studies are included.

Each section summary briefly reviews the main points presented in the section, which should facilitate learning of the material. The emphasis (and strength) of this book, is its integration of anatomy and movement. The organisation of the muscles by joint movement, the thorough description of joint structures, the description of how to identify muscles and bony landmarks by palpation, and the inclusion of the biomechanics of movement at each joint successfully matches how sports therapist actually use their anatomical knowledge.

Robert Di Leva April 2008

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Paper in journal

Higgott, R. (1998) The Asian economic crisis: a study in the politics of resentment', *New Political Economy* 3(3): 333-336.

Blinder, A.S. and Solow, R.M. (1970) 'Analytical foundations of fiscal policy', *Journal of Finance* XXV: 47-54.

Bender, J., Bloggs, B. and Swistak, P. (1997) 'The evolutionary stability in cooperation', *American Political Science Review* 91(3): 290-297.

Book

Giddens, A. (1990) *The Consequences of Modernity*, Cambridge: Polity.

Kay, J., Mayer, C. and Thompson, D. (1986) *Privatization and Regulation*, Oxford: Clarendon Press, pp. 105-129.

Brown, C. (ed.) (1994) *Political restructuring in Europe: Ethical Perspectives*, London: Routledge.

Chapter in book

Hook, G.D. (1998) 'Japanese Business in Triadic Globalization', in H. Hasegawa and G.D. Hook (eds.) *Japanese Business Management: Restructuring for Low Growth and Globalization*, London: Routledge, pp. 19-38.

Conference paper

Altenstetter, C. (2001) 'Multi-level implementation networks: The case of medical devices and patient care'; Seventh Biennial Conference of the European Community Studies Association (US), Madison, Wisconsin, 31 May-2 June.

Thesis

Zito, A. (1994) 'Epistemic communities in European policy-making' Ph.D. dissertation, Department of Political Science, University of Pittsburgh.

Newspaper article

Barber, L. (1993) 'The towering bureaucracy', *Financial Times*, 21 June.

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