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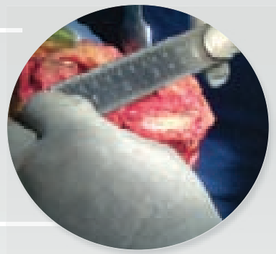

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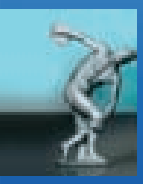

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International Society for Knowledge for Surgeons on Arthroscopy and Arthrosplasty (ISKSAA) is happy to launch its official, peer-reviewed, scientific journal, *Journal of Arthroscopy and Joint Surgery* (JAJS), the first volume of which rolls out in January 2014. It is a bi-annual journal and is published by Elsevier, a division of Reed-Elsevier (India) Private Limited. JAJS welcomes contributions from across the world. The Editorial Board comprises of well-known experts from across the globe.

The Journal is committed to bring forth scientific manuscripts in the form of original research articles, current concept reviews, meta-analyses, case reports and letters to the editor. The focus of the Journal is to present wide-ranging, multi-disciplinary perspectives on the problems of the joints that are amenable with Arthroscopy and Arthroplasty. Though Arthroscopy and Arthroplasty entail surgical procedures, the Journal shall not restrict itself to these purely surgical procedures and will also encompass pharmacological, rehabilitative and physical measures that can prevent or postpone the execution of a surgical procedure. The Journal will also publish scientific research related to tissues other than joints that would ultimately have an effect on the joint function.

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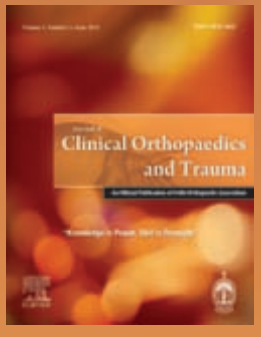

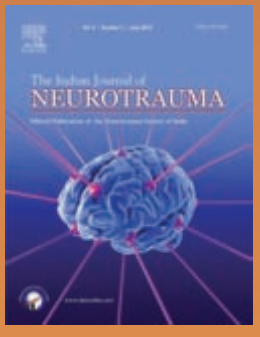

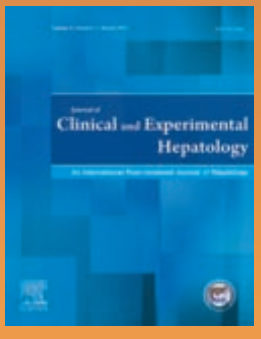

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Editorial

Note from Editors

It gives us great pleasure to welcome you to the first issue of the **Journal of Arthroscopy and Joint surgery** (*JAJS*). The *JAJS* is the official Journal of the 'International Society for Knowledge for Surgeons on Arthroscopy and Arthroplasty' (ISKSAA). Many of you would be familiar with the ISKSAA, which was created with the main aim of sharing knowledge among a global network of surgeons. It has made great strides in the last few years and the *JAJS* is a further step in this direction. With the *JAJS*, we hope to develop a trusted and respected International Journal which would be a source of the latest evidence for the orthopaedic community.

The focus of the Journal is to present wide-ranging, multidisciplinary perspectives on the problems of the Joint that are amenable to arthroscopy and arthroplasty. However, the Journal is not restricted to surgical procedures. We would also like to include topics relating to pharmacological, rehabilitative and physiotherapy measures that can prevent or postpone the need for surgical procedures and can help patients pursue their activities, relating to work or sport, unhindered.

The *JAJS* has an Editorial board of top global experts and is a peer reviewed journal. The Journal is being professionally managed by Reed Elsevier India Pvt. Ltd. The Journal is committed to bringing forth original scientific manuscripts in the form of research articles, current concept reviews, meta-analyses, case reports and letters to the editor.

In the first issue, we have been fortunate to have reviews and original articles from eminent surgeons who are experts in their fields. We would especially like to thank: Prof Simon Donell, President of British Association for the Surgery of the Knee; Mr David Limb, Chair, Education and Revalidation Committee, British Orthopaedic Association and Dr Sanjay Desai, Vice President, Indian Arthroscopy Society for their contributions. We look forward to the engagement of our readers in the future, both with submissions and suggestions for improvement. If you would like to comment on any aspect of the Journal or would like to get involved as a reviewer, please get in touch at: editorjajs@gmail.com.

We hope you enjoy this issue and find it educational and informative.

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Editorial

Osteoarthritis and knee replacement

A patient presenting with pain experienced around the knee for a prolonged time is challenging to manage. A number of problems must be considered if the patient is to benefit from the consultation. When considering the knee the important point is that the pain may be felt at the knee, but the site of injury may also be in the hip, spine or in the central nervous system. The principal pathological process causing injury leading to pain in patients over 50-years-old is osteoarthritis. The temptation for orthopaedic surgeons, in patients with knee pain and radiological changes consistent with osteoarthritis, is to assume the two are connected and therefore perform a knee replacement. Wylde et al[1] noted around 10%–15% of patients following total knee replacement had not had relief of their pain symptoms. One interpretation is that the prosthesis was not implanted accurately, or that the shape or size of the prosthesis was not optimum. Much of the innovation in knee replacement in the last 20 years has been based on this belief. An alternative interpretation is that the abnormal bearing surface seen on X-ray was not the source of the pain.

Besides referred pain, it is also important to realise that chronic pain causes alteration in the central brain connections leading to memory of the pain.[2] This is analogous to phantom limb pain. The International Association for the Study of Pain defines chronic pain as that which persists beyond the time of the initial injury.[3] Although the damaged articular cartilage in the knee led to the experience of pain, replacing it with an artificial bearing has no effect on the central perception. Patients requiring opiates to manage knee pain prior to operation are much more likely to continue needing opiates post-replacement, and have no change in their function or experience of pain.

A further point to consider is that the general population over 50-years-old with radiological changes consistent with osteoarthritis is larger than the population with knee pain, which is, in turn, larger than those that present to secondary care for treatment, which may take the form of a knee replacement. As orthopaedic surgeons we tend to see a very selected patient group. This poses a number of questions which we do not know the answers to. Why do some patients seek a knee replacement when they have a painful knee and significant changes on X-ray, but others do not? What are the proportions of these two groups? Why do many people have changes on X-ray and yet do not get pain? Alternatively, since there are people with radiological changes that are identical, why do some develop pain and others do not? The answers may lie in the known risk factors; obesity, poor diet, lack of exercise. My personal view is that there is little difference between ageing articular cartilage and osteoarthritic cartilage at the level an orthopaedic surgeon needs to consider. However when a patient loses fine muscle control of the knee (which includes rotational control of the femur from the hip rotators; particularly *gluteus maximus*) then the patient experiences pain. Obviously an episode of acute arthropathy with synovitis and an effusion will lead to muscle weakness. This can then lead to persistence of the pain. A slim, motivated and active patient can regain control of the knee and become pain-free. This is much less likely in an overweight, sedentary person with multiple co-morbidities.

It should also be noted that in Western European cultures the knee as a joint has significant sociocultural undertones.[4] The word for the knee in Latin languages is the same as for parenthood and generation (genu). In Anglo-Saxon your "kinsman" is your "knees man". The knee is important in many ways such as you sit on your parent's knee and pray on your knees. Patients who are psychologically distressed may express this as knee pain (especially children).

Therefore patients over 50-years-old presenting with pain in the knee should be carefully assessed. The ideal patient for a knee replacement is fit and active at aged 70-years-old, has a mobile knee with a correctable varus. The hips and spine are normal. The X-ray that shows bone-on-bone changes with osteophytes formation, tibial plateau and femoral condylar margins. The worse the X-ray looks the better. This patient is unlikely to have any of the risk factors for a poor result. They are usually male. The further away the patient is from this ideal, the less likely a knee replacement will benefit them. Addressing poor diet, obesity, lack of exercise, and appropriate pain relief, management from a Pain Consultant if chronic pain is the major feature, before performing a knee replacement, is much more likely to benefit the patient. Remember, a normal knee can be painful, and a knee with a prosthesis can be painful. In the latter, the prosthesis may not be the reason for the pain.

Conflicts of interest

The author has none to declare.

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Editorial

The right path to super-specialization

Living beings broadly consists of plants, animals and humans. Plants have a body but no mind or intellect (power of reasoning; known as "budhi" in Indian scriptures – Vedas). Animals have a body and mind, but no intellect. Only human beings have a body, mind and intellect. Therefore only humans have a right to choose. For example, a tiger cannot choose to be a vegetarian or a cow cannot choose to be a meat eater. As orthopedic surgeons we also have to choose an area of specialization. So how does one decide?

In the early 90's in the United Kingdom, Arthroscopy was in its early stages and Arthroscopic shoulder surgery was just being born. 'Arthroscopist' was a concept prevalent mainly in the USA and some parts of Europe. There is a fundamental flaw in this form of specialization. It is more of an equipment dependent specialization, with inherent dangers of a tunnel vision. Being equipment intensive technology, which is also expensive, it might inadvertently exert pressure on the surgeon to misuse the technique or admit an expensive mistake. Equipment-based specialization can be impractical and occasionally harmful to the patient. For example, how does a patient with early medial compartment osteoarthritis of the knee know whether Arthroscopic surgery or High Tibial Osteotomy or Uni knee replacement will solve his/her problem? Besides there can be situations where we may need to abandon arthroscopic surgery in favor open procedure. This would be beyond the 'scope' of the so-called Arthroscopist. It is this misdirected form of specialization which has probably lead to introduction of once popular procedures such as arthroscopic debridement of osteoarthritic knee and subacromial decompression, which are rapidly failing the test of evidence based medicine. Shoulder surgery is an ideal example where one is incomplete without the expertise in open shoulder surgery. With further evolution of shoulder surgery, procedures such as Reverse shoulder replacement are going to be more and more in demand.

I am convinced that super-specialization is here to stay and good for the patient as well as the doctor. However, region-wise specialization seems more scientific, practical and safe. There are less chances of bias in selecting the right procedure if the same surgeon is trained to do arthroscopy or high tibial osteotomy or uni knee replacement.

In summary, there is little ambiguity that region-wise, instead of equipment-based specialization is the right path to super-specialization. I urge all the young surgeons, when making the choice between an arthroscopist v/s knee or shoulder surgeon, use your intellect, for this is a privilege bestowed only to the human beings.

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Review Article

A review of functional anatomy and surgical reconstruction of medial patellofemoral ligament

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Keywords:
Medial patellofemoral ligament
Anatomical attachments
Femoral tunnel placements
Graft selection

ABSTRACT

Background: Recurrent patella dislocation is a very disabling condition. The stability of patellofemoral joint depends on many general and local factors. It is believed that the Medial Patellofemoral Ligament (MPFL) is one of the major stabilisers of the patellofemoral joint in early knee flexion. Injury to the MPFL occurs in almost every patellar dislocation. This result in a significant increase in lateral patellofemoral joint tracking and contact pressures, which may affect long-term articular cartilage health. Therefore, in recent years MPFL reconstruction has become a popular surgical option in the treatment of patella instability. However there is still a growing debate regarding the correct surgical technique and post-operative rehabilitation. In addition, the long-term effect of MPFL reconstruction procedure on the patellofemoral joint is unknown. Recent research has emphasised the importance of anatomic femoral tunnel placement with the help of intraoperative radiograph. Mal-positioned femoral tunnels and over tensioned grafts during MPFL reconstruction have been reported to result in adverse outcomes such as joint stiffness, pain, recurrent instability and possibly early degenerative joint changes.

Aim: To review of our current knowledge of the anatomy, function and the surgical reconstruction of MPFL

Methods: We conducted cadaveric dissection to understand the anatomy of MPFL, its femoral and patellar attachments and its role in the functional stability of the patellofemoral joint. We also describe the surgical reconstruction of the MPFL using hamstring tendons, technique and accurate placements of femoral tunnel.

Results: Our findings showed that the MPFL insert in an area midway between the adductor tubercle and medial epicondyle of the femur, dorsal to an extended line from the posterior cortex of the femur and attaches to the superomedial portion of the patella, and under the surface of the Vastus Medialis Obliquus tendon (VMO). The ideal graft for reconstruction is the gracilis tendon. The femoral tunnel entry point is behind the posterior cortex of the femur and above the Blumensaat's line.

Conclusion: We conclude that anatomic femoral attachment and minimal tension during reconstruction of MPFL is essential for a successful outcome.

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1. Introduction

Patellar dislocation has been reported to account for 3% of all knee injuries.[1] with an incidence of between 29 and 43 individuals per 100,000 reported.[2,3] The results of conservative treatment have been unsatisfactory at short- and long-term follow-up. Clinical reports highlight instability, pain and loss of function. These undesirable symptoms are frequently identified in follow-up studies from clinical populations suffering patellar dislocation.[4–6]

Patellofemoral joint stability is maintained by three mechanisms.[7] Dynamic stability is provided mainly by the quadriceps and the gluteal muscles to a certain extent.[8] The static stability is provided by the bony anatomy and configuration of the patella and trochlear groove.[9] The passive joint restraint is provided by the local ligaments and retinacula.[10] Each mechanism is thought to have an important role in the range of knee flexion, with the Medial Patellofemoral Ligament (MPFL) identified as the most important joint stabiliser from 0°–30°. It contributes to more than 50–60% of the passive resistance to lateral patellar motion through this early range.[11]

2. Anatomy

The MPFL was initially thought to only be present in 29–88% of knees,[12] but has since been shown to be a consistently present structure in all knees.[13] However there is discrepancy and debate about its precise anatomical attachment on the femur.[14] This has been attributed to by the complex anatomy on the medial side of the knee.[15] On an average of the MPFL is approximately 53 mm long, with a range of 45–64 mm in anatomical specimens.[16] Ligament fibres have been reported to widen towards both patellar and femoral attachments. The width of MPFL at the femoral origin has been reported to range between 10 and 25 mm.[8,13,17]

The tissues covering the antero-medial aspect of the knee has been identified to be arranged into three distinct layers.[1] The MPFL has been defined in the second layer below the deep fascia, but superficial to the joint capsule.[18] Here it shares a close relationship with the superficial and superior fibres of the medial collateral ligament (MCL) and adheres to the vastus medialis oblique muscle (VMO) (Fig. 1). Significant overlapping of the ligament fibres of both the MPFL and MCL at this point makes identification of MPFL as single unit very difficult.[10,15,17,19]

2.1. *Femoral attachment*

The medial femoral condyle is covered by many closely compact structures that are very difficult to separate and hence the discrepancies in describing the femoral attachment of the MPFL. Most authors describe the femoral attachment of the MPFL in relation to landmarks such as the medial epicondyle, medial collateral ligament and the adductor tubercle and indeed some reports use these interchangeably.[11,16] Amis et al[1] inaccurately concluded that the MPFL originated from the origin of the medial epicondyle of the femur, whilst Davis et al[20] described the MPFL to take its femoral origin from adductor tubercle and medial epicondyle. Desio et al[10] describes a wide attachment for MPFL which is spread by decussating fibres attaching to both the adductor tubercle and the superficial fibres of the MCL, with more direct attachment

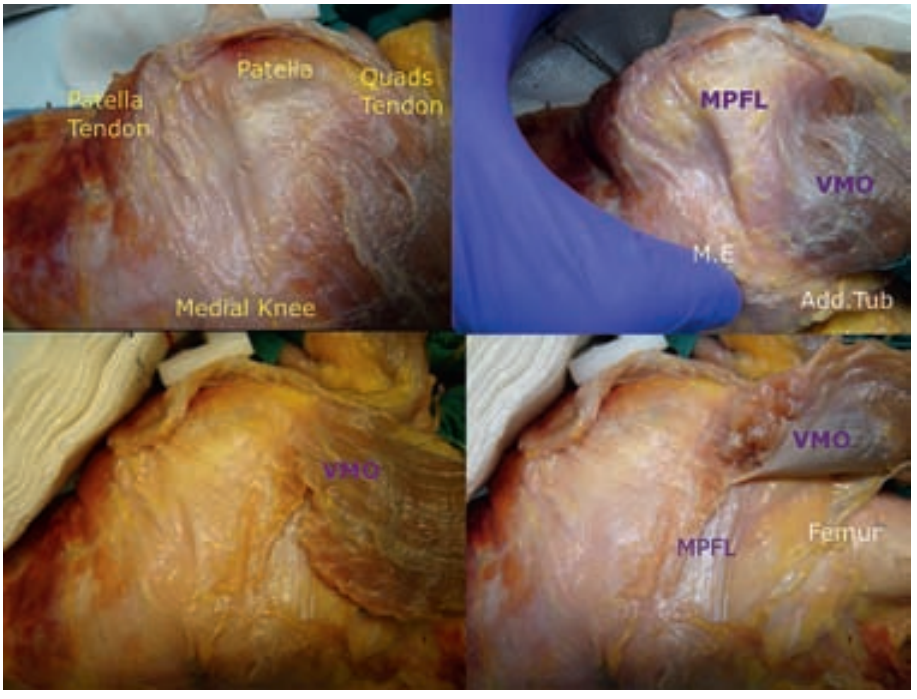

Fig. 1 – Medial aspect of the knee showing the MPFL attachment to the upper 2/3 of the patella and to the area between the medial epicondyle and the adductor tubercle. It also shows how the VMO adheres to the MPFL.

to the epicondyle. In a comprehensive study undertaken by Baldwin,[3] it was outlined that the adductor tubercle provided exclusive attachment for the adductor magnus tendon and the medial epicondyle exclusive attachment for the medial collateral ligament. Between these two landmarks a groove was described, which the MPFL is attached. Bicos et al[15] defined a similar point in an anatomical review of the knee joint. Our own dissection showed that the MPFL insert in an area midway between the adductor tubercle and medial epicondyle of the femur, dorsal to an extended line from the posterior cortex of the femur (Fig. 2).

2.2. *Patellar attachment*

The medial attachment of the MPFL to the patella and local soft tissues has been somewhat less contentious, although some variations still exist. Commonly described points of attachment include the medial upper two thirds of the proximal patella,[21] proximal half of the patella,[1,12] and the superomedial aspect of the patella via the vastus medialis tendon.[13] It appears now in many studies to be generally accepted that the MPFL attaches to the superomedial portion of the patella, and under the surface of the Vastus Medialis Obliquus tendon (VMO) (Fig. 1).[22] However despite frequent imaging and measurement studies, its relationship with the VMO tendon is not consistently defined.[15] The close anatomical location of the MPFL with the MCL and VMO adds strength to the theoretical fact of the stabilising function of the MPFL.

3. Function

Patellar tracking has been highlighted as a complex motion pattern, significantly influenced by the geometry of the trochlear groove, the magnitude and direction of joint restraints. In the actively fully extended knee the patella has been identified to be tethered in a distal poster-medial direction by the tight medial retinaculae, particularly the MPFL.[13] A reduction in MPFL tension has been found when the patella moves medially in early knee flexion, and this is the point where the patella is least stable, because it has not engaged with the trochlear groove.[7] Increased knee flexion causes the distal aspect of the femur to roll back on the tibia, due to its cam shape, leaving a gap behind the patella, which results in this retinacular slackness. This provides rationale for the MPFL slackening as the knee flexes and supports the stabilising role of the MPFL.

Strength studies of the MPFL follow on from this work, and appear to provide a consistent basis for the consideration of the ligament as a restraint to the lateral motion of the patella. The MPFL has been found to have a mean failure load of 208 N with the femur stabilised and patella distracted in an anteromedial direction until it ruptures.[23] Some surprise was initially expressed at the resilience of the ligament, with several authors emphasising the measurements could be underestimating the strength, given the mean cadaver age used for testing was 70 years. Previously it has been referred in relation to the anterior cruciate ligament that it demonstrates approximately 2.5 times its strength in the third decade compared to the seventh.[24] This work also strengthens the argument for the stabilising role of the MPFL.

Fig. 2 – Medial aspect of the knee showing the MPFL (1), medial epicondyle (2) the adductor tubercle (3) and patellar attachment of MPFL (4).

4. Injury

Pathological features associated with patellar dislocation, such as trochlear dysplasia and patella alta are well highlighted in the literature.[2,25] However, a further subset of patients suffer dislocation in the absence of bony pathology, often as a result of a twisting motion or direct trauma to the knee.[25] Considering its anatomical position, patellar dislocation is not possible without damage to the MPFL.[23] Surgical and MRI reports have identified MPFL injury in 100% of cases following patellar dislocation, with complete rupture identified in 95–100% of those examined.[17,26,27] Reports suggest that neglecting to repair the medial structures following dislocation can result in recurrence and inferior results.[12,28] In addition to MPFL rupture, osteochondral bruising, lesions and fractures of the medial facet of the patella and or lateral condyle are commonly identified following dislocation.[4,26,29]

Cadaveric studies have previously identified alterations in patellar kinematics and mechanics following MPFL rupture. Ostermeier et al[30] identified up to a 4 mm increase in lateral patellar translation and 4.5° lateral tilt following MPFL rupture. Philippot et al[31] reported increases of up to 7.2 mm and 7.6° in lateral translation and tilt respectively following MPFL section, although a very low quadriceps load of 10 N was used. These changes in mechanics suggest a lateral tracking of the patella following injury. This is clinically relevant when considered alongside articular cartilage defects reported following patellar dislocation.[4] It may raise concerns for the future secondary osteoarthritis and suggests requirement for surgical reconstruction following injury.

5. Surgical reconstruction

Clinical outcomes following MPFL reconstruction have generally demonstrated positive results at short- and mid-term follow-up with low re-dislocation rates and good functional outcomes.[32–35] However, there are reports of patients

who suffer recurrent dislocation, pain and poor function following reconstruction, and later requiring revision surgery.[36,37] Adverse outcomes have been suggested to result from non-anatomic femoral tunnel positioning[28] or over tensioned grafts during the procedure,[37] both leading to alter patellar kinematics and joint contact pressures.

5.1. *Femoral tunnel position*

Ligament isometry assumes that fibres of the ligament do not change length as a joint passes through its range of motion. The native MPFL has previously been identified as "close to isometric",[38,39] with the length changes most sensitive to the femoral origin of the ligament, suggesting its importance in surgical outcome following reconstruction.[6] This is similar to reported literature in relation to ACL reconstruction, where correct femoral tunnel positioning is paramount to a successful post-operative outcome.[40] Evidence suggests that failure to secure an anatomically accurate femoral attachment may result in altered ligament tension and adversely impact on patellofemoral joint contact pressures. Excessive tensioning of the ligament during reconstruct leads to change in the force distribution and increased medial patellofemoral pressures, cartilage degeneration, pain and subsequent development of secondary arthritis.[36,41]

As discussed previously the precise origin of the MPFL is widely debated, however an anatomic femoral tunnel position, confirmed by fluoroscopy, has been proposed and confirmed as anatomical in the literature for use during MPFL reconstruction.[42,43] Schottle et al[43] describe the proximal-distal position of the anatomic MPFL femoral attachment as situated between the horizontal line transecting the most posterior part of Blumensaat's line and that tangential to the most superior part of the posterior femoral condyle. Whilst the anterior-posterior MFPL position is defined as the anatomic point located slightly anterior to the extension of the line of the femoral cortex.[38,43] This is in conflict with our own observation Fig. 3, which showed the anatomic attachment to be more posterior than Schottle's area. However it remains to be seen what is the long-term effect of slightly mal-positioned femoral tunnel on the development of secondary osteoarthritis in the medial PFJ. Recent reports by Servien et al[44] showed in the short-term patients still did well even if the tunnels are well out of place. They reviewed 29 MPFL reconstructions post-operatively and determined 19 to be correctly positioned in accordance with Schottle et al,[43] while 10 were either proximal or anterior to the anatomic position. Clearly mal-positioned tunnels that are well fixed will not fail but increases the contact pressure in the medial PFJ either in extension or flexion. Ligament length change patterns previously investigated by Smirk et al[22] identified that an anteriorly situated tunnel would result in a mean MPFL tightening of 12 mm, potentially therefore resulting in increased medial patellofemoral joint contact pressures. These results must be interpreted with caution, as the study used embalmed cadavers.

Femoral tunnel positioning has been investigated in cadaveric studies by Melegai et al,[45] and was found to have no effect on patellar mechanics. However, only two femoral attachments were investigated on the femur and these were not well standardised. Furthermore, the authors applied axial loading to the quadriceps, did not load the ITB, and used a small sensor which did not cover the full surface are of the trochlea, therefore caution must be used when interpreting these results. Clinically non-anatomic femoral tunnel placement during MPFL repair has been identified as the only significant risk to surgical failure,[46] 80% of patients with an incorrectly positioned femoral tunnel resulted in dislocation up to four years post-operatively. A case series reported symptoms of on-going pain, recurrent dislocation and joint degeneration in five patients. All the five patients needed revision surgery as a consequence of non-anatomic femoral tunnel position during MPFL reconstruction.[36] This is substantiated by ligament length change reports, which have identified non-anatomic femoral attachment. It can cause shortening of the ligament potentially resulting in increased joint contact pressures.[22] Our recently published work showed that proximally or distally placed tunnel adversely affect patella tracking and contact pressure.[47]

Fig. 3 – Intraoperative image intensifier used to obtain a true lateral knee view. The femoral tunnel entry point (*x*) is behind the posterior cortex of the femur and above the *Blumensaat's line* (white dotted line). Also shown the anchors used to fish the graft to medial patella.

5.2. *Graft selection*

The ideal graft for medial patellofemoral ligament reconstruction should have structural and biomechanical properties similar to those of the native ligament. It should permit secure fixation, and limit donor site morbidity. Graft choice depends on surgeon experience and preference, tissue availability, patient activity level, co morbidities and prior surgery. A range of different tendons has been reported for the use of MPFL reconstruction including gracilis,[48] quadriceps[28] and semitendinous.[35] Short- and mid-term follow-up studies have reported positive outcomes following reconstruction using each of these different grafts,[28,35] however no longer term studies are currently available to establish any differences in outcomes with each graft type. The gracilis graft more recently has been considered the most optimal for use, with

some concerns raised about its tensile strength. The MPFL has been found to have a strength failure of 208 N,[23] and the gracilis tendon is thought to replicate these properties.[49]

5.3. *Graft tension*

At present, there is limited research to suggest a graft tensioning protocol for use during MPFL reconstruction surgery. There is a need to compromise between too slack a graft potentially permitting lateral patellar subluxation, versus over constraint, which may cause medial instability or increased medial joint contact pressures. The MPFL is almost isometric through knee range of motion once the patella has engaged with the trochlea, slackening minimally in early flexion.[38] This would suggest it has a minimal tension and that tensioning could affect post-operative outcome. Elias et al[18] designed a computer generated knee model to stimulate knee function from 0°–30°. They took in to consideration three scenarios namely an intact MPFL, anatomically correct MPFL reconstruction and a 3 mm shortened MPFL reconstruction. Findings showed that increasing tension on the MPFL caused more medial patellar tilt and load on the medial patellar facet. Although a computer model based on numerous assumptions of graft characteristics highlighted the influence of tensioning on potential post-operative outcome. Beck et al[50] supported these findings using cadaveric knees to demonstrate increased medial pressures resulting from over tensioned MPFL grafts, suggesting as low a tension as 2 N as sufficient to restore joint contact pressures to pre-operative levels. Clinical studies have reported the adverse consequences of over tensioning resulting in post-operative pain and necessitating later revision surgery.[37] The present contact pressure findings highlights the potential for articular cartilage damage as a consequence of an over tight graft. Outcomes demonstrates that only minimal graft tension is required to restore patellar mechanics and should serve as a caution against over tensioning to surgeons performing MPFL reconstruction.[31]

A second factor, which could affect joint mechanics post-operatively, is the angle of knee flexion in which the knee is positioned when the graft is tensioned. A range of angles for tension application are discussed in the literature ranging from 0-90°.[51] However at present no consensus opinion exists as to the most optimal knee position for graft fixation or its consequences. It could be hypothesised that graft tension with the knee in a position where the patella is constrained in the trochlear groove, with the MPFL in a lengthened position, would be optimal to restore normal joint kinematics. Therefore many surgeons choose to tension the graft at 30–70° of knee flexion, although there is no direct evidence at present to support this theory.

6. Conclusion

The MPFL has been determined as the major static restraint to lateral patellar translation.[12] The loss of its function has been shown to significantly increase lateral patellar tracking and lateral joint contact pressures.[30] These changes when considered alongside osteochondral defects reported at the time of dislocation[29] have potential consequences for the long-term articular cartilage and joint function. MPFL reconstruction is a growing technique conducted worldwide and with recent findings suggesting its superiority and importance in treatment of patients suffering patellar dislocation. Its popularity as an intervention is likely to rise further in future. We stress the importance of anatomic femoral attachment and minimal tension during reconstruction of MPFL is essential for a successful outcome.

Conflicts of interest

All authors have none to declare.

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Review Article

Rotator cuff repair in older patients

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ABSTRACT

Increasingly, older patients expect a higher level of independence than people of previous generations. Traditionally rotator cuff tears in patients over 65 years of age were thought to be unsuitable for surgical repair even though patients may have reduced shoulder function as a result. With improved health of the older population, surgeons are now prepared to repair the torn rotator cuff. Published results of this surgery are discussed. Other treatment options such as physiotherapy, injections together with subacromial decompression, cuff debridement, tuberoplasty and reverse polarity shoulder replacement are considered.

1. Introduction

Rotator cuff tear (RCT) is a common cause of shoulder pain. MRI studies have shown the prevalence to be 28% in subjects over 60 years,[1] rising to 38% of over 70 years,[2] while 30% of cadavers of over 60 years have rotator cuff tears.[3] The incidence is expected to grow as the population ages and remains active. This same population also expects to be independent and is reluctant to accept functional limitations.

The age of 60 or 65 years, the retirement ages in developed countries, is said to be the beginning of old age. The United Nations describe 'older' people as those above the age of 60 years. The World Health Organisation reported that better living standards and nutrition, due to socioeconomic development in Asian developing nations, is reducing death rates and increasing the elderly population.[4] This explosion of the elderly population is inverting the demographic pyramid to a "top heavy" configuration. The elderly now consider that their longevity is preserved through keeping active and maintaining independence.[5]

In both the developed and developing worlds alike, chronological time has little or no importance in the meaning of old age with biological ageing being a more practical marker.[6] Taking into account the physical, mental and social functioning of each elderly individual, rather than solely considering chronological age would be more meaningful in guiding physicians in the management of lifestyle altering illnesses. The management of orthopaedic conditions, including RCT in the older patients should thus be considered in the same manner.

2. Rotator cuff tear and ageing

The pathogenesis of RCT has been extensively researched but is still not fully understood. RCT occurs through a complex

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interplay of intrinsic (intratendinous) factors and extrinsic factors. Trauma can certainly be identified in some presentations but equally, RCT's could occur in a proportion of patients without identifiable injury.

Intrinsic changes within the rotator cuff accompany ageing, the most important being reduction in vascularity of the tendon. Furthermore, age negatively impacts on tendon properties, with decreased elasticity, tensile strength, increased calcification and fibrovascular proliferation.[7] It is not clear if these factors contribute to tendon tears or vice versa, but we do know that both increase proportionately with age.[8]

Not surprisingly, RCT dimension correlate positively with age, with greater proportion of massive RCTs (>5 cm) observed in >65 years. Consequently, more technically challenging RCT repairs in this patient group are encountered. Anchoring RCT repairs is also compromised, as osteoporosis around the greater tuberosity is frequently present.[9,10] Increasing age has also been correlated with increasing re-rupture rates and poorer outcome following repair.[11,12]

Furthermore, the elderly frequently have comorbidities such as diabetes, rheumatoid arthritis and renal disease that weaken tendons and impair healing response. In particular, the increasing prevalence of obesity and diabetes in the ageing population is a major contributing factor to tendinopathy.[13] These, and other comorbidities, pose surgical and anaesthetic challenges.

For the reasons cited above, there has historically been reluctance among shoulder surgeons to offer surgical repair for RCT in this group. Some even argue that RCTs are natural progression of ageing and do not represent a pathological process. As symptoms of weakness, pain and functional limitations becomes unacceptable to the active elderly in our society, this view is increasingly disputed. Anaesthetic advancements, such as regional anaesthesia and surgery without general anaesthetic, together with refinement in surgical techniques, have encouraged repair of RCT to be offered.

3. Clinical presentation and indication for RCT repair

Whilst RCT can often be minimally uncomfortable, there are some classic symptom and signs. On presentation, typical features of RCT are pain over the anterolateral aspect of the shoulder, radiating towards the deltoid insertional area. This pain might frequently take the form of modest muscular ache. Sharp catches of mid arc impingement pain may also be observed. In advanced disease, weakness in mid abduction and flexion becomes apparent. Nocturnal pain is also frequently encountered. Pseudoparalysis, where the deltoid defunctions as it is no longer under tension due proximal migration of the humerus, usually represent advanced disease. In such circumstances RCT repairs might be prohibitively challenging. However, one must distinguish between true pseudoparalysis as opposed to pseudoparalysis from pain, as the RCT in latter might still be repairable.

Diagnostic tests have been extensively debated but ultrasonography performed by a skilled operator is reliable. This is the standard practice in our institution. MRI without arthrogram is notoriously unreliable in the shoulder and we would urge that if any such scans are to be undertaken, gadolinium arthrography enhancement is a prerequisite.[14]

3.1. *Indications for treating a cuff tear in over 65*

The aims of rotator cuff repair surgery are to reduce pain and improve strength and function. The argument against repairing cuff repairs in older patients, when surgery is not contraindicated, requires review. As stated earlier, older people are functioning at a higher level at a greater age than in previous generations and there is a pressing need to maintain upper limb function in this patient group.

Surgery is indicated when symptoms fail to resolve despite non-operative measure. Particularly, repair of RCT should be considered if the tear is acute and traumatic, the tear is small and the cuff not retracted, and if the cuff tendon appears to be of relatively good quality on pre-operative investigations.

The RCT is most reliably and definitively assessed at the time of surgery following a thorough bursectomy. If the tear appears reducible to the footprint, releases are performed, comprising of subacromial bursa excision, releases of adhesions, coracohumeral ligament release and interval slides. The improved tendon excursion allows the rotator cuff to be repaired without tension, either with a single or double-row configuration. It is when the cuff is retracted or the tissue appears poor that we do not attempt a repair, especially if the patient has got a pseudoparalysis.

In the situation where surgery is already underway and the cuff appears repairable, we believe that there is no greater morbidity with repairing the cuff rather than debridement only. Indeed studies suggest patients who have undergone repair have better functional outcome than those undergoing debridement alone.[15–17] In our experience, the cuff repair does not add considerably to the length of surgery or the morbidity of the patient. Following cuff repair we immobilise the shoulder in a sling for 4 weeks allowing passive motion. We have not found this to be difficult for our older patients or to be associated with any increase in morbidity such as frozen shoulder.

There are situations where we believe RCT repairs in patients over the age of 65 years should not be considered. Patients unsuitable for RCT repair include those with significant frailty, patients who are unable to comply with postoperative rehabilitation or those with advanced RC disease. In some cases other operations should be considered, such as in the cases where cuff tear arthropathy is present and joint replacement surgery is more appropriate.

The more controversial area encountered in indicating repair is the situation of mildly symptomatic patient with investigation-proven RCT. The argument for a surgical repair is the prevention of deterioration towards advancing weakness and pain and avoidance of cuff tear arthropathy. In our unit, we feel that this argument remains to be proven and as such, we counsel against repairs in such situations. The benefits of surgery has not been shown to clearly outweigh potential risks, hence RCT repair surgery is only offered if there are intrusive symptoms and limitation of function.

4. Results of rotator cuff repair in older patients

There are numerous publications of RCT repairs that correlated poorer outcome with advancing age.[11,12] There are a few papers that have investigated RCT repairs specifically in the older patients and these are summarised in Table 1[18–23] and Table 2.[24–28] Arthroscopic RCT repairs (ARCR) have gained wider popularity in the last 20 years, with the advantage of small incisions, avoidance of deltoid morbidity, less pain and quicker recovery. Not surprisingly, papers of rotator cuff repair in the older aged patients began to appear in peer-reviewed publications in the last few years (Table 2).

All these papers have shown surgery to be beneficial in relieving pain, measured separately as visual analogue score (VAS) or as part of functional scoring schemes. Most patients are satisfied with the outcome of rotator cuff repairs, with accompanying improvement in strength and active movement ranges. Shoulder specific functional scores were also improved in the majority of papers, as were quality of health scores. Some factors have been identified to be poor prognostic indicators. These include: older age of patient, female sex, higher ASA grade and long duration of symptoms prior to surgery. In addition repairs of large or massive RCT's, involvement of multiple tendons and in particular, involvement of subscapularis tendon, have also been implicated to adversely affect outcome.

Table 1 – Peer-reviewed publications of open and mini-open rotator cuff repair.

Open RCR	Year	Study	*n*	FU (months)	Age (yr)	RC tear feature	RC repair	Outcome
Worland et al[18]	1999	Retrospective therapeutic cohort series	69	Min 24, mean 36	>70 (70–90)	Massive tear: 100%	Bone trough, bone tunnel/bridge, good bone tendon repair 80%, fair 5%	UCLA 78.2% Good or Excellent. Arthrogram in 12 good repairs, 91.7% no/small leak
Lam and Mok[19]	2004	Retrospective therapeutic cohort series	74	Mean 48, 24–94	>65	Massive tear: 100%	TiCron, Mason–Allen, transosseous tunnels, good repair 68%, poor 32%	Excellent/good 44% C-M and Oxford. 93% less pain. Female, higher ASA, longer duration symptoms related to poored outcome
De Carvalho et al[20]	2012	Retrospective therapeutic cohort series	80, 88 shoulders	Mean 40.8	>70	Small: 5%, med: 20%, large: 48%, massive: 27%	Bone trench, suture anchor	Improved Simple Shoulder Test and C-M score. 92.7% satisfied. None limited by shoulder in return to pre-injury function. 100% pain free or mild symptoms

Mini-open RCR	Year	Study	*n*	FU (months)	Age (yr)	RC tear feature	RC repair	Outcome
Hattrup et al[21]	1995	Retrospective cohort comparison (>65 vs <65)	88: 53 > 65, 35 < 65	Mean 19, 12–48	>65	Small: 3.4%, med: 38.6%, Large: 35%, Massive: 23%	Bone tendon repair 90%	Greater prevalence of larger RC tears in >65. Percentage excellent/satisfactory 91% >65 vs 97% in <65. Excellent outcome 89% small tear vs 80% large/massive tears
Grondel et al[22]	2001	Retrospective therapeutic cohort series	92 pts, 97 shoulders	Mean 35, min 24	>62	Small: 4%, Med: 27%, large: 39%, massive: 30%	No5 Ethibond, bone trough, bone bridge, no suture anchors	UCLA 87% Good or Excellent. Massive tear worse UCLA. No difference younger vs older patients on UCLA. 5% failure of repair. 98% satisfied
Fehringer et al[23]	2010	Retrospective cohort comparison (Study group vs untreated controls)	39 pts, 42 shoulders (vs 104 pts/200 shoulders controls)	Mean 32, 12–60	>65	SST only 60%, SST & IST 29%, 3-tendon 7.6%	Bone trough, bone tunnel/ bridge	USS healed repair in 76%, Simple Shoulder Test and C-M equivalent to normal controls. Healed repairs scored better than unhealed repairs and untreated control with tears

Table 2 – Peer-reviewed publications of arthroscopic rotator cuff repair.

	Year		*n*	FU (months)	Age (yr)	RC tear feature	ARCR	Outcome
Rebuzzi et al[24]	2005	Retrospective therapeutic cohort series	54	Min 24, mean 27	>60	Small: 11%, med: 33%, large: 26%, massive: 30%	Single row, inc. margin convergence with no suture anchor	UCLA significantly improved. 81.4% Good/Excellent. Size of tears and age no influence on outcome. 30 deg gain active flexion. Margin convergence useful in >65.
Charousset et al[25]	2010	Prospective therapeutic cohort series	81	Mean 41, range 24–77	>65	SST only 50%, 2 tendons: 35%, 3 tendons: 15%	Single row	58% complete/ partially healed on CT arthrogram at 6 month. Re-tear 42%. Better strength and functional scores in healed/ partially healed repairs. Small/ medium tear healed better.
Osti et al[26]	2010	Prospective cohort comparison (>65 vs < 65)	56 in study, 28 > 65 vs control	Min 24, mean 27	>65	Small: 11%, Med: 54%, Large/massive: 35%	Single row, LHB release in all	No difference in >65 and <65, 96% good/ excellent in both groups. Improved UCLA, SF36, active flexion and strength.
Verma et al[27]	2010	Retrospective therapeutic case series	44	Min 24	>70	Small: 33%, med: 48.7%, Large: 15.4%, Massive: 2.6%	Single row	Improved ROM, pain, ASES, SST, C-M scores. C-M 82–98% of age- & sex-matched normalised C-M.
Robinson et al[28]	2013	Prospective therapeutic cohort series	69	12 to 60	>70	Small: 7.2%, Mod: 24.6%, Large: 29%, Massive: 26.1%	Single row	C-M improved at I yr. Male had better scores. USS re-tear rate 32%, age affected re-tear survival

UCLA: The University of California at Los Angeles shoulder rating scale.
ASES: The American Shoulder and Elbow Surgeons Evaluation Form.
SST: Simple Shoulder Test.
C-M: Constant-Murley Scale.

All but three of these papers are prospective or retrospective review of cohorts. Fehringer et al,[23] Hattrup[21] and Osti el al[26] have embarked upon comparative studies against validated control groups: in Fehringer et al's study, 200 controls of similar age with untreated shoulder (with and without rotator cuff tears) were selected. Hattrup divided his retrospective cohort to over and under 65 years of age for the purpose of comparison; while Osti et al performed a prospective comparative study of older rotator cuff surgery patients against controls of under 65-year-old. These papers showed no significant differences in outcome between their study groups and the selected control populations. In the Osti paper however, they had proportionally more male patients and this factor might influence the conclusion.

Two of these studies have also evaluated the healing potential of the repaired cuff in this age group. Robinson et al[28] evaluated his cohort of 69 over 70-year-old patients after single row ARCR with ultrasonography and found a re-tear rate of 32%, with Kaplan–Meier re-tear free survival markedly different between <77 years and >77 years. Charousset et al[25] studied tendon healing after single row ARCR with CT arthrography in 81 over 65-year-old patients. They found 52% rate of healing overall: 42% having re-torn at 6 months, 100% re-tear in their 6 massive tears, with significantly lower Constant-Murley score in patients with re-tears. While these papers suggest that cuff re-tear rates may be higher in the older patients, re-tears did not always correlate with return of symptoms.

Of the five papers that investigated arthroscopic repairs of rotator cuff repairs in the older patients, all operations were performed with the single row technique. Most surgeons presently favour the technique of double-row repair with

"footprint reconstruction". This technique has been shown to be superior biomechanically, if not clinically, to the single row repair.[29] Evidence that the double-row repair can provide similarly superior outcome in the more mature patients will certainly be welcomed.

5. Alternatives to rotator cuff repair

A myriad of alternatives exist in the management of RCT and can broadly be categorised to operative and non-operative interventions.

5.1. Non-operative alternatives

5.1.1. Physical therapy

There is little evidence to support the use of physical therapy in elderly patients with cuff tears.[30] Levy et al[31] and Itoi[32,33] both showed improved outcome scores in the short-term. A systematic review[34] concluded that exercise is effective to reduce pain, home exercise programs may be as effective as supervised exercise, and that the effect of exercise may be augmented with manual therapy.

5.1.2. Injections

The use of steroid injections to treat cuff tears has sparse supportive evidence, but the practice is widespread and appears to provide anecdotal relief. A Cochrane review concluded that the available evidence from randomised controlled trials supports subacromial corticosteroid injection for rotator cuff disease, although the effect is limited and short-lived, possibly no more effective than non-steroidals.[35]

Subacromial hyaluronic acid injections seem to give effective short-term pain relief and improve outcome scores. Shibata et al compared subacromial injections of hyaluronate to dexamethasone and demonstrated similar improvement of outcomes at 6 months.[36]

5.2. Operative alternatives

Surgery should be considered in patients deemed to have irreparable RCT's, but are healthy enough for surgical intervention.

5.2.1. Subacromial decompression (SAD)

Rockwood reported on 50 patients treated with SAD and cuff tear debridement, mean age of 60 years; 83% were satisfied, with improved pain and shoulder flexion.[37] Gartsman described a 79% improvement, with significant reduction in pain, improvement in range of motion, but a reduction in strength. These results were still inferior to those achieved with repair.[38] The long-term benefits of this treatment are questionable; Zvijac et al re-evaluated 25 patients who had undergone SAD, at 45.8 months, finding only 68% of patients had maintained their improvement in pain and function, but there was no loss of motion or strength.[39] When performing this procedure in the presence of massive RCT, it is essential not to resect the coracoacromial (CA) ligament. This acts a static restraint to anterosuperior humeral head migration.[40,41]

5.2.2. Tuberoplasty

Tuberoplasty or reverse subacromial decompression, where the exposed tuberosity is resected along with cuff debridement to produce a congruent articulation with the acromion, is thought to benefit by decompressing without affecting the CA ligament. This technique has produced some positive results in the short to mid term.[42,43]

5.2.3. Long head of biceps (LHB) tenotomy or tenodesis

LHB tenotomy is commonly combined with cuff debridement and decompression procedures, but has been shown to be of benefit as a single procedure. Described by Walch et al in 1990,[44] this technique has been adapted as an arthroscopic pain relieving procedure and can be augmented with tenodesis. The LHB is thought to be a pain generator and has a passive role in humeral head depression.[45] Walch et al demonstrated in 307 tenotomy patients, at mean 57 months follow up, 87% satisfaction and significantly improved Constant scores. Interestingly, within this group, 110 patients had accompanying acromioplasty; this group had better outcomes if their acromiohumeral distance was greater than 6 mm.[46] In a retrospective review of 68 patients, mean age 68 years, treated with either LHB tenotomy or tenodesis alone, 78% were satisfied, with significantly improved Constant Scores. There was no difference between tenodesis or tenotomy. Those with true pseudoparalysis, rather than pain induced pseudoparalysis, had no benefit from LHB surgery.[47]

5.2.4. Tendon transfers

For an irreparable cuff or failed RCT repair, in the absence of osteoarthritis, tendon transfers have been used in younger patients. For absent superoposterior cuff, the latissimus dorsi is used with good effect.[48,49] With a deficient anterior cuff, the pectoralis major can be utilised.[50,51] To our knowledge, there is no report to date of tendon transfer procedures performed specifically in the older patients.

5.2.5. Arthroplasty

Arthropathy in the presence of a massive cuff tear with pain ultimately requires arthroplasty. Total shoulder arthroplasty is inappropriate due to a high rate of glenoid component loosening, leading to the use of hemiarthroplasty.[52] The presence of true pseudoparalysis would push one to consider a reverse polarity shoulder replacement (RPSR).

Hemiarthroplasty is an established technique; it is contraindicated in the presence of anterosuperior humeral escape. Results are mixed; successful outcomes are reported between 63% and 67%, with pain relief achieved but poor functional improvement.[53,54]

RPSR is very popular for rotator cuff arthropathy as this implant compensates well for the absent rotator cuff. Early results have shown increased range of motion, pain relief and good functional outcomes,[55–57] however some report a complication rate of up to 50%, including; dislocation, infection, fracture of glenoid and humerus, and base plate loosening. More recent studies comparing hemiarthroplasty to RPSR suggest there are similar outcomes in patients less than 65 years of age with either prosthesis, but significantly better outcomes with the RPSR in those over 65 years.[58,59]

6. Conclusion

Anatomical restoration of the damaged structure remains the preferred option in most surgical conditions. We believe that the torn rotator cuff should be treated in a similar fashion, with surgeons endeavouring to surgically repair the torn tendons whenever feasible.

However, a surgeon must also give due consideration to other options. Functional requirements might indeed be lower in the older patient compared to younger patients with RCTs. It is important that conservative options are fully explored before RCT repair. In recalcitrant cases, subacromial decompression and cuff debridement might be appropriate if RCT repairs are deemed too demanding. If there is arthropathy of the glenohumeral joint, reverse shoulder arthroplasty might be appropriate. Our management plan for RCT in the older patients can be summarised in the flow diagram (Fig. 1).

Established indications for surgery in the younger patients with RCT can be applied to the older patients. In our opinion, arthroscopic RCT repair is preferred as it is comparable to the more invasive open or mini-open surgery. Whilst there is evidence that age affects the outcome, with older patients attaining poorer result, reasons for this are not entirely clear. Healing potential of the repaired rotator cuff might indeed be poorer, but at the same time, larger and more chronic cuff tears were observed in the older patients. These factors emphasise the need to attain optimum mechanical support and favourable biological environment to encourage cuff healing. If the RCT repair fails, a plethora of options are still available for salvage. Repairing RCTs with the least invasive technique would not compromise a surgeon's ability to perform other procedures e.g. conversion to a reverse shoulder arthroplasty.

Additionally, the older patients are a unique group in that comorbidities are more frequently encountered. Their ability to comply with a very involved physiotherapy programme after surgery must also be taken into consideration. It would be ideal to have an assessment tool to evaluate the older individuals with regards to their needs and to assess physical and mental capacity. Perhaps too, formal use of biological age or biological markers for ageing could be more widespread and might assist physicians to recommend the more appropriate options in RCT.

Repairs of the torn rotator cuff in this age group must be individualised, taking into account the needs of each patient and their carers. Health care purchasers, commissioners and insurers are increasingly rationing treatment, especially when conclusive benefit is not proven. Surgery such as subacromial decompression has been subjected to scrutiny by health insurers prior to authorisation. Such restrictions take away the clinician's ability to consider the merits of each case individually and undermine the independence of the profession. This has yet to occur in RCT repairs, but is not inconceivable with

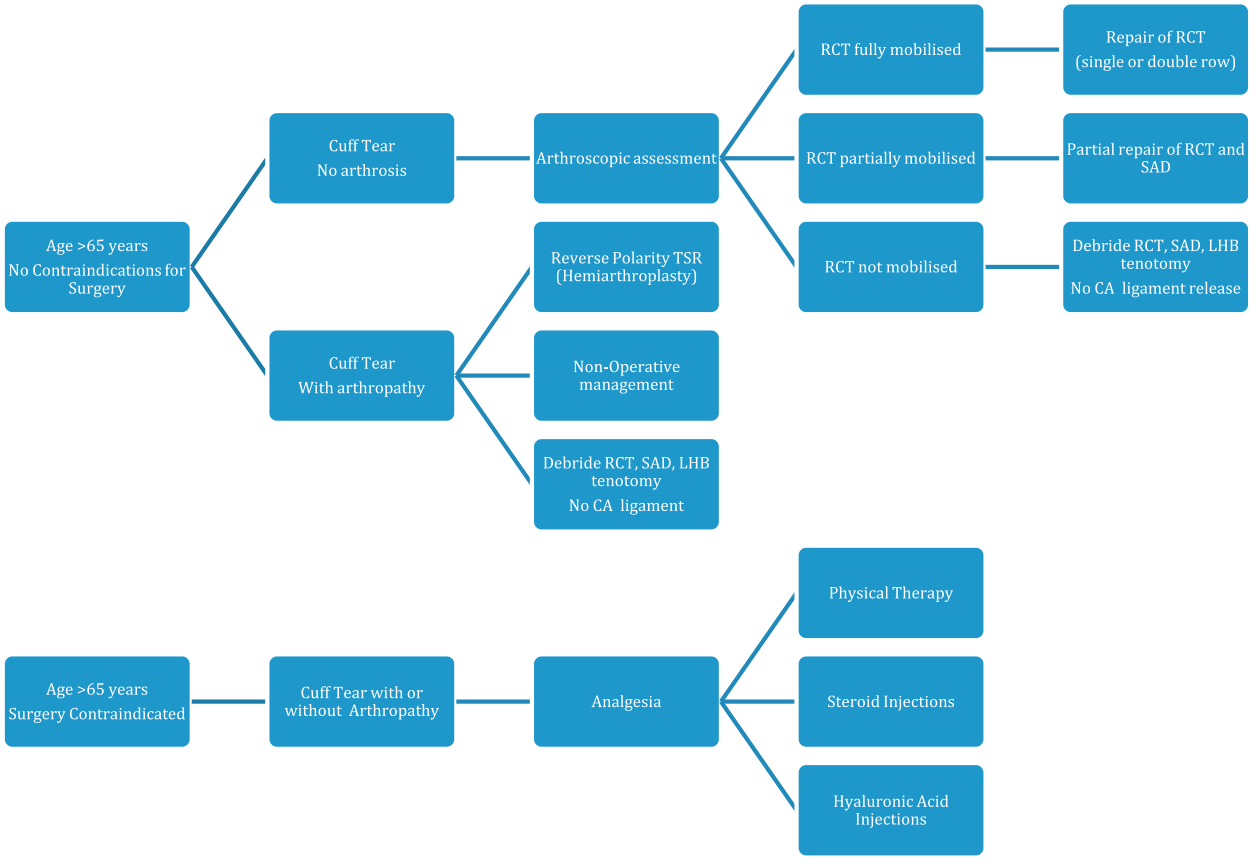

Fig. 1 – Flow diagram outlining our management plan for patients of over 65 years presenting with rotator cuff tear.

escalating cost of health care. If restrictions are imposed based on age alone, a significant proportion of patients with the torn rotator cuff would be deprived of a solution to their symptoms, consigning them to pain and reduced capacity to maintain their much-valued independence.

Conflicts of interest

All authors have none to declare.

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Review Article

Ankle arthritis: Review and current concepts

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ABSTRACT

The ankle joint bears a very high load per unit of surface area. It has thinner cartilage as compared to hip or knee. If the surface area of the joint is decreased or the congruency is lost, then the pressures rise quickly, leading to arthritis. This is the reason for trauma being the most frequent etiological factor for ankle arthritis.

Steroid injections can provide short-term relief. The role of intra-articular hyaluronic acid is controversial. Ankle arthroscopy is useful in early arthritis but is not effective in severe arthritis. Supramalleolar osteotomies have gained increasing popularity for the treatment of early and mid stage arthritis associated with varus or valgus deformity of ankle. Distraction ankle arthroplasty might be a treatment option for young patients though currently there is not much evidence to support its role.

Ankle arthrodesis results in significant improvements in terms of pain and function and has been considered the gold standard for the surgical treatment of end stage ankle arthritis. In the last few years, arthroscopic ankle arthrodesis has gained increasing popularity, with reports of shorter hospital stays, shorter time to solid fusion, and equivalent union rates when compared with open arthrodesis. Ankle replacement has gained popularity in the last 15 years. The advantages of this surgery include: preserved movements, less stress on other joints and improved gait. The current third generation implants have resulted in improved outcome and better survivorship. However, the results of ankle replacement are still inferior to hip and knee replacement. The reported ten-year survivorship of ankle replacement ranges from 69 to 84%.

1. Introduction and biomechanics

The ankle joint bears about four times the body weight in stance phase. In addition it has a small surface contact area of only 522 square mm, which is one third as compared to hip or knee.[1] No wonder that it bears a very high load per unit of surface area. Biomechanically, the ankle joint is highly congruent. Although its cartilage is thinner as compared to hip and knee (1.5 mm), it has good resistance against tensile and shear forces allowing it to withstand high pressure. Normally these factors keep the contact pressures at low level. This can explain that symptomatic ankle arthritis is nine times less prevalent as compared to knee arthritis.[2] But if the surface area of the joint is decreased or the congruency is lost, then the pressures rise quickly, leading to arthritis. It has been reported that 1 mm of lateral talar shift reduces tibio-talar contact by 42%.[3,4] There is significant reduction in tibio-talar

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contact (13%) with posterior malleolar fractures involving more than 33% of articular surface. Deltoid ligament transection does not seem to alter any change in tibio-talar contact area.[5] This is the reason that the most common cause of ankle arthritis is posttraumatic involving malleolar fractures or lateral ligament injury.

2. Etiology

Unlike the hip and knee, which are prone to develop primary osteoarthritis, the ankle develops arthritis usually because of a traumatic event. In 70% patients with ankle arthritis there is a history of trauma (ankle fracture or a significant ankle sprain). In an epidemiological survey, the onset of ankle OA was attributable to a previous fracture (37.0%), recurrent sprains (14.6%), a single sprain/pain (13.7%), pilon fracture (9.0%), tibial shaft fracture (8.5%), and osteochondral lesion of the talus in 4.7% cases.[6] The second most common cause of ankle arthritis is an inflammatory pathology with an incidence of 17%. Other rare causes include infection and crystalline arthropathy.

3. Assessment

3.1. *Clinical picture*

The patient with severe ankle arthritis commonly presents with antalgic gait. Gait analysis in patients with ankle arthritis typically shows decreased velocity; stride length and cadence with increased time in double-limb stance.

The most common location of pain is anterior which gets worse by walking uphill. Pain caused by going downhill suggests problem at the back of ankle usually due to posterior impingement. Pain caused by walking on uneven grounds is indicative of subtalar joint problems. In early arthritis the movements are usually well preserved. In late stages of ankle arthritis the movements (dorsiflexion & plantar flexion) are restricted. Assessment of alignment of the ankle and hindfoot is particularly important, as the presence of severe deformity changes treatment options. Chronic lateral ligament injury and malunitedtalar neck fracture usually leads to varus deformity whereas syndesmotic injury or mal reduced Weber C fracture causes a valgus deformity. Assessment of movements of ankle joint helps in decision-making regarding surgery, as an ankle replacement cannot restore the loss of movements. A poor soft tissue envelope is a relative contraindication for open surgery. Vascular and neurological assessment must be done in every case.

3.2. *Radiographs*

The standard views are standing Anteroposterior and Lateral views. Weight-bearing film is critical to assess true deformity and joint space narrowing. In most cases further investigations are not required. However, an MRI scan is useful in avascular necrosis of talus. A CT scan is a useful test in evaluating bone defect.

4. Treatment

4.1. *Non-surgical*

Non-surgical measures must be considered before surgery. These include: Oral and topical anti-inflammatory medication, ankle brace, activity modification, weight loss, use of stick in contralateral hand and lace up boots. Steroid injections can provide short-term relief. The role of intra-articular hyaluronic acid is controversial. A recent RCT showed that a single intra-articular injection of low molecular weight, non-cross-linked hyaluronic acid is not demonstrably superior to a single intra-articular injection of saline solution for the treatment of osteoarthritis of the ankle.[7] On the other hand a metaanalysis and systematic review suggests that multiple injections of intra-articular HA administration can significantly reduce pain in ankle OA compared with the condition before treatment, and it is likely superior to reference therapy (Fig. 1).[8]

4.2. *Surgical*

4.2.1. *Arthroscopic debridement*

Ankle arthroscopy is performed using non-invasive distraction and most commonly using anteromedial and anterolateral portals. This is useful in early arthritis. It does not help in severe arthritis. In one series, 70% good or excellent results were achieved with arthroscopic treatment of synovitis, loose bodies, osteochondral defect or osteophytes, compared with only 12% in patients with generalized arthritis.[9] Glazebrook et al published evidence-based indications for ankle arthroscopy.[10] According to their paper there exists fair evidence-based literature (grade B) to support a recommendation for the use of ankle arthroscopy for the treatment of ankle impingement and osteochondral lesions and for ankle arthrodesis. Ankle arthroscopy for ankle instability, septic arthritis, arthrofibrosis, and removal of loose bodies is supported with only poor-quality evidence (grade C). Treatment of ankle arthritis, excluding isolated bony impingement, is not effective and therefore this indication is not recommended (grade C against). Finally, there is insufficient evidence-based literature to support or refute the benefit of arthroscopy for the management of synovitis and fractures (grade I) (Fig. 2).

Fig. 1 – Anteromedial arthroscopic portal most commonly used for ankle injection.

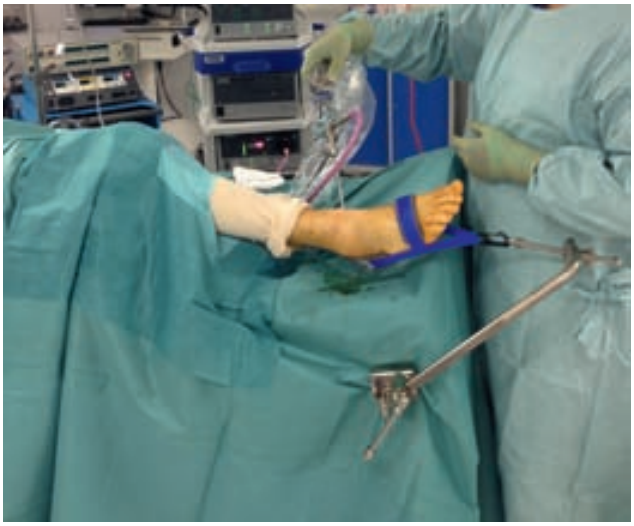

Fig. 2 – Set up for ankle arthroscopy.

4.2.2. Open debridement

The indication for this procedure is large osteophyte with impingement, which is not amenable to arthroscopic surgery. Results of debridement in generalized arthritis with joint space narrowing or deformity are poor.[11]

4.2.3. Fibular osteotomy

After fibular fracture, if the distal fibula is not anatomically reduced, instability and resultant arthritis can occur. The fibula is most often shortened and externally rotated, allowing abnormal subluxation of the talus. These patients may present late, after fracture healing, with persistent pain. Radiographs may show decreased overlap of the distal fibula and anterior tibia on the AP view, or widening of the tibio-fibular clear space on the mortise view. Osteotomy as an isolated procedure, however, is contraindicated in cases where significant arthritis has already taken place. It is indicated in patients with fibular malunion and pain to restore fibular length and ankle stability. The goal of fibular osteotomy is seating of the distal fibula into the incisura-fibularis and restoration of a symmetric joint space. Walker and colleagues published their small series of seven patients with malunited fibular fracture presenting with persistent pain. A transverse fibular osteotomy was made just above the ankle joint and below the tibio-fibular syndesmosis. A tri-cortical iliac bone graft and a lateral fibular plate were applied. Union occurred in all the patients and clinically all these patients improved at a short-term follow-up of 11 months.[12]

5. Distal tibial (supramalleolar) osteotomy

As 63% of the patients with severe ankle joint arthritis present with a malalignedhindfoot,[13] supramalleolar osteotomies have gained increasing popularity for the treatment of early and mid stage arthritis. Supramalleolar alignment correction in the varus and valgus type arthritis of the ankle joint (asymmetric arthritis) has shown to reduce pain, improve function and radiological signs of arthritis, as well as postpone fusion or the need for replacement surgery. Takakura introduced the opening wedge supramalleolar osteotomy for varus ankle arthritis in 1995 and reported good to excellent results in 15/18 patients.[14] The three patients in their series, who had fair result, had either under correction or little residual cartilage on the lateral aspect of the joint. Myerson in 2003 reported that the AOFAS scores improved from 53.8 to 87 in all 12 patients who had a supramalleolar

Fig. 3 – (a): Varus deformity of left ankle. (b): Opening wedge supramalleolar osteotomy left ankle.

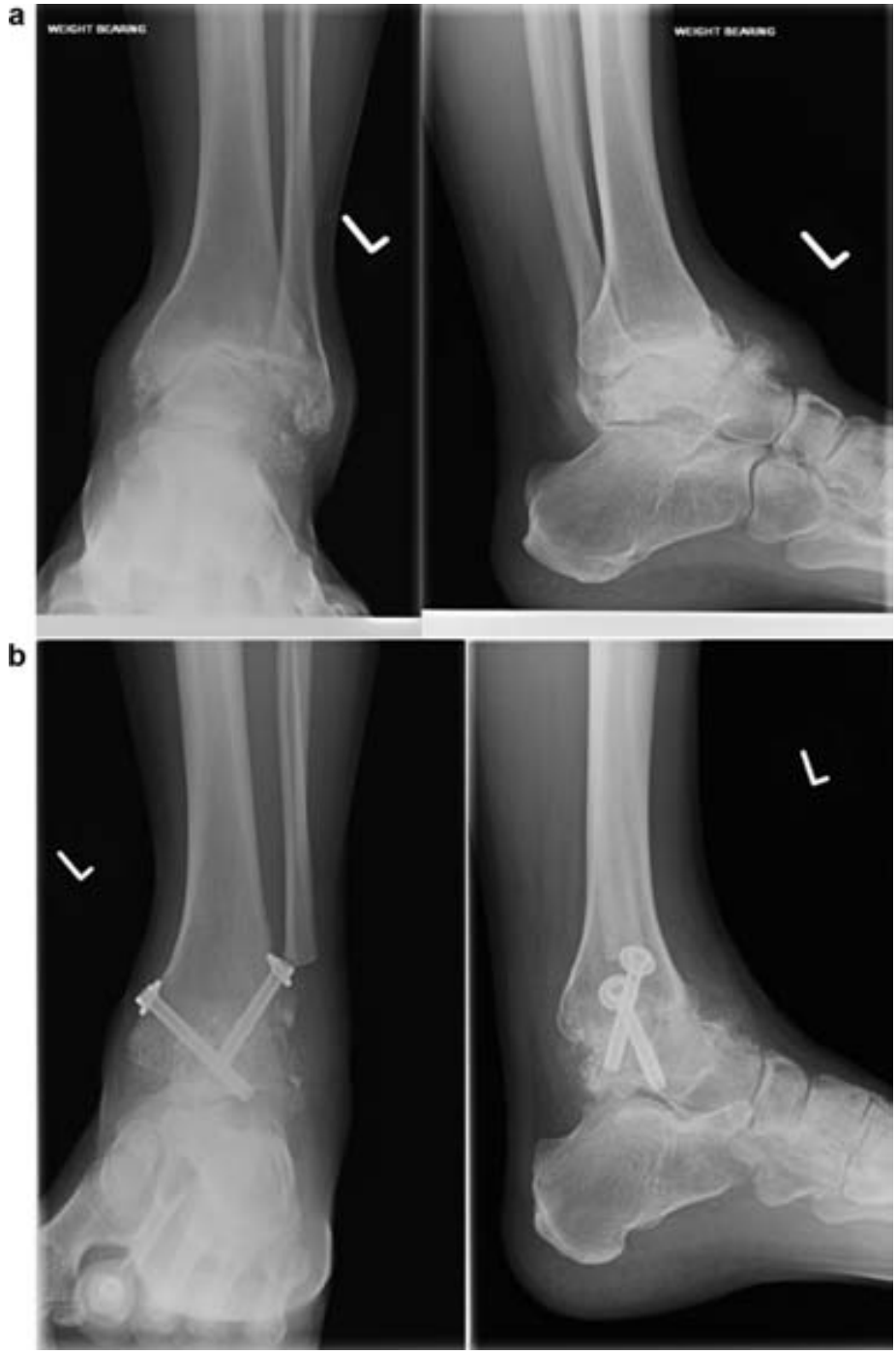

Fig. 4 – (a): Ankle arthritis with deformity. (b): Open ankle fusion performed by transfibular approach.

osteotomy over a five-year period.[15] Hinterman reported his results for this surgery in valgus ankle arthritis in 2009 reporting that 20 of his 22 patients improved at an average follow-up og 4.5 years.[16] However, in their series additional procedures were performed depending on the stage of disease. In a prospective study Hinterman's group have reported good to excellent results in 87.5% patients (sample size 48, mean follow up 7.1 years) in malunited pronation external rotation ankle fractures treated by realignment osteotomy of distal tibia and fibula (Fig. 3).[17]

6. Distraction arthroplasty or arthrodiastasis of ankle joint

Distraction arthroplasty is indicated for young patients with ankle arthritis. The theory is that, by distracting and off-loading the joint the cartilage may repair and regenerate. The procedure involves placing a ringed external fixator on the involved ankle and distracting the joint between 5 and 10 mm. The fixator may be articulated at the ankle, allowing

Fig. 5 – Arthroscopic ankle fusion using two parallel medial screws.

movement, or it may be fixed. The period of distraction varies between 8 and 14 weeks.

The technique is based on data from animal studies in which immobilization and distraction reduce mechanical forces across the joint while maintaining intraarticular flow and pressure. Because chondrocytes depend on diffusion for nutrition, maintenance of intraarticular flow without mechanical stress may promote enhanced repair of cartilage. There are, however, no human data showing cartilaginous repair, and animal data show only suggestive evidence.

For select patients, distraction ankle arthroplasty may be a promising treatment approach for ankle osteoarthritis; however, there is still limited literature addressing its efficacy and clinical long-term results.

Smith et al in 2012 reviewed the literature regarding evidence of distraction ankle arthroplasty and concluded that currently there is inadequate evidence-based literature exists to support or refute all currently accepted indications for distraction ankle arthroplasty.[18]

7. Ankle arthrodesis

Ankle arthrodesis results in significant improvements in terms of pain and function and has been considered the gold standard for the surgical treatment of end stage ankle arthritis. It provides fairly predictable results and reliable pain relief albeit with some associated gait abnormalities and increased stresses on the adjacent joints. In contrast to other major joints ankle fusion can result in less or no functional limitation provided there is preserved movement in the hindfoot joints. Position of fusion is important as malunion can cause problems. Neutral position is preferred and varus deformity should be avoided at all costs. Traditionally ankle fusion has been performed by open approach (anterior or transfibular) (Fig. 4).

In the last few years, arthroscopic ankle arthrodesis has gained increasing popularity, with reports of shorter hospital stays, shorter time to solid fusion, and equivalent union rates when compared with open arthrodesis. A multicenter comparative series with 30 patients in each group and follow up duration of two years has reported significantly greater improvement in the Ankle Osteoarthritis Scale score at one year and two years and shorter hospital stay in the arthroscopic arthrodesis group. Complications, surgical time, and radiographic alignment were similar between the two groups.[19]

Moore and colleagues reviewed 62 patients who had ankle arthroscopic fusion.[20] They divided them into two groups: with or without significant deformity. They reported uniform good to excellent results in both groups with an overall union rate of 91% (94% in group without deformity and 88% with significant deformity). The time to union was 8.8 weeks in first group and 12.7% in the later group with average union time of 10.4 weeks (Fig. 5).

8. Ankle replacement

Ankle replacement has gained popularity in the last 15 years. The advantages of this surgery include: preserved movements, less stress on other joints and improved gait. The current third generation implants have resulted in improved outcome and better survivorship. However, the results of ankle replacement are still inferior to hip and knee replacement. There are certain factors, which have made development of ankle prosthesis difficult. The intrinsic factors are: increased load and low contact area of this joint resulting in increased stress at bone implant interface, complexity and vascularity of talus causing technical difficulties in the design of ideal talar component and poor soft tissue envelope around ankle. The extrinsic factors, which are important in ankle replacement surgery, include:

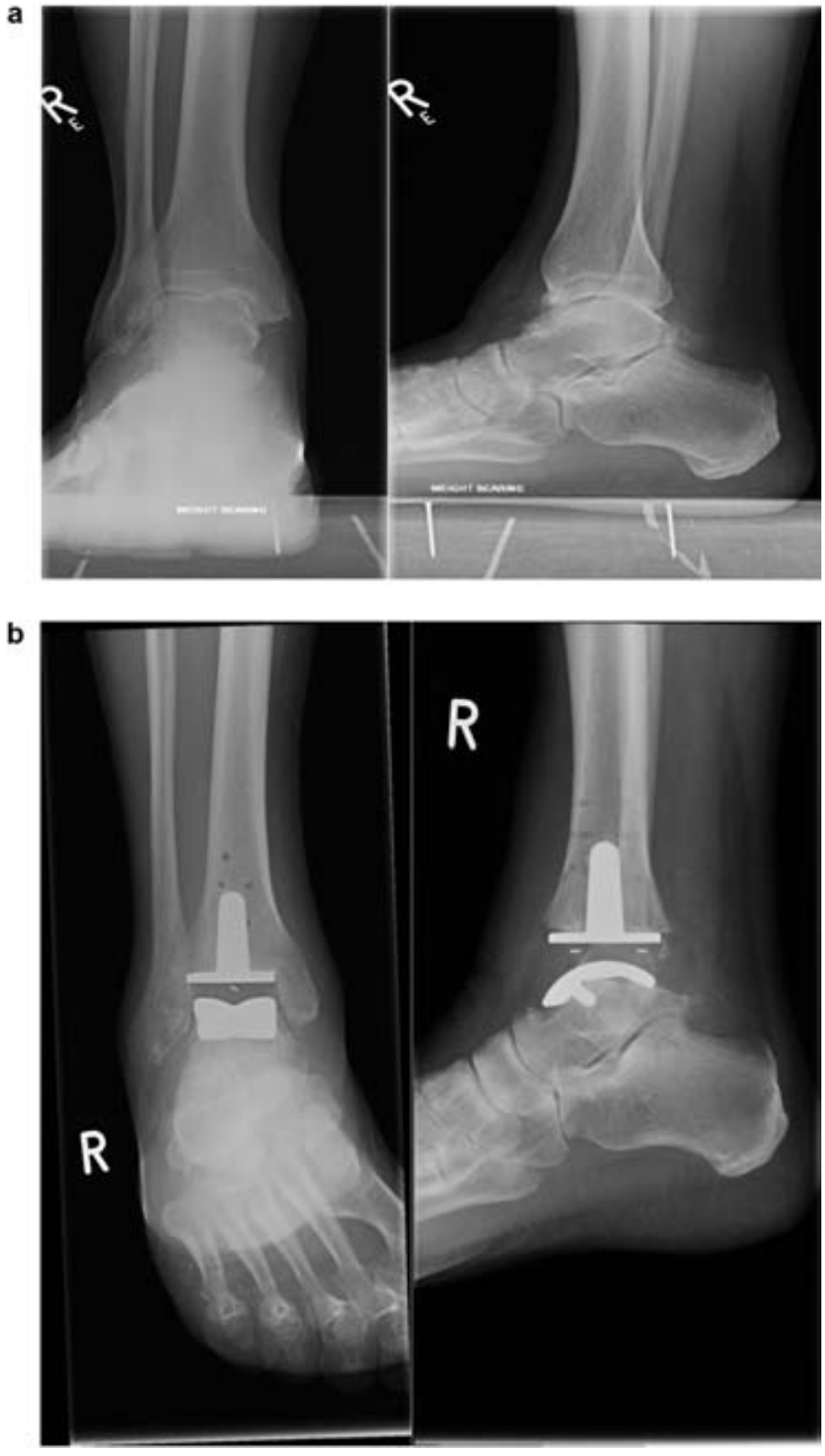

Fig. 6 – (a): Preoperative radiographs showing ankle arthritis. (b): Three years following ankle replacement.

balance between congruence and constraint and fixed or mobile bearing implant. The ideal candidate for ankle replacement surgery is a low demand patient with preserved movements and deformity less than 10 degrees.

Heddad et al did a systematic review of literature in 2007 to compare the intermediate and long-term results of ankle replacement and ankle arthrodesis.[21] The systematic review identified forty-nine primary studies, ten of which evaluated

total ankle arthroplasty in a total of 852 patients and thirty-nine of which evaluated ankle arthrodesis in a total of 1262 patients. The mean AOFAS (American Orthopedic Foot and Ankle Society) Ankle-Hindfoot Scale score was 78.2 points (95% confidence interval, 71.9–84.5) for the patients treated with total ankle arthroplasty and 75.6 points (95% confidence interval, 71.6–79.6) for those treated with arthrodesis. Meta-analytic mean results showed 38% of the patients treated with total ankle arthroplasty had an excellent result, 30.5% had a good result, 5.5% had a fair result, and 24% had a poor result. In the arthrodesis group, the corresponding values were 31%, 37%, 13%, and 13%. The five-year implant survival rate was 78% (95% confidence interval, 69.0% to 87.6%) and the ten-year survival rate was 77% (95% confidence interval, 63.3%–90.8%). The revision rate following total ankle arthroplasty was 7% (95% confidence interval, 3.5%–10.9%) with the primary reason for the revisions being loosening and/or subsidence (28%). The revision rate following ankle arthrodesis was 9% (95% confidence interval, 5.5%–11.6%), with the main reason for the revisions being nonunion (65%). One percent of the patients who had undergone total ankle arthroplasty required a below-the-knee amputation compared with 5% in the ankle arthrodesis group. They concluded that the intermediate outcome of total ankle arthroplasty appears to be similar to that of ankle arthrodesis; however, data were sparse. Comparative studies are needed to strengthen this conclusion.

Hinterman's group has reported survivorship studies in 684 patients for Hintegra Ankle replacement.[22] Hinterman has designed this implant. They have reported overall survival rates are 94% at 5 years and 84% at 10 years for this implant.

A systematic review of outcome of STAR ankles has reported the five-year survival rate as 85.9% & the 10-year survival rate as 71.1%.[23] The main reasons for implant failure were aseptic loosening (5.2%), malalignment (1.7%) and deep infection (1.0%).

The results from Swedish ankle register show overall survival rate of 81% at 5 years, falling down to 69% at 10 years.[24] However, if STAR ankles are excluded then the survival rate at 10 years is 78%. Women below the age of 60 with osteoarthritis were at a higher risk of revision, but age did not influence the outcome in men or women with rheumatoid arthritis. The authors conclude that although the results of ankle replacement are slowly improving, the survivorship of ankle replacements would not match hip or knee replacements in the near future (Fig. 6).

9. Summary

The most common cause of ankle arthritis is posttraumatic due to fractures or significant repeated ankle sprains. It can be treated non-surgically in initial stage by NSAIDs, ankle brace and steroid injection. Ankle arthroscopy can be effective for early to moderate ankle arthritis. Supramalleolar osteotomy is an attractive option for ankle arthritis with deformity for a young patient. Arthroscopic ankle fusion is the preferred technique for arthrodesis due to less morbidity and quicker recovery. In late arthritis ankle fusion or ankle replacement can be chosen depending on deformity, patient demands, arthritis of neighboring joints and movements of ankle joint. The intermediate results of ankle replacement are similar to ankle fusion. Although the modern third generation implants have improved outcome of ankle replacement, the results still do not match hip or knee replacement.

Conflicts of interest

All authors have none to declare.

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Original Article

Should primary care physicians perform routine long-term follow-up of total hip arthroplasty patients?☆

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Hip replacement
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ABSTRACT

Background: It has been suggested by some that follow-up of primary total hip arthroplasty (THA) patients should be performed by primary care physicians (general practitioners or GP's in the UK), rather than by orthopaedic specialists. Such follow-up would, most likely, include radiographic follow-up based on review of radiographic reports.
Aim: To look at the quality of the radiographic reports to determine their usefulness as a method of radiographic follow-up of THAs.
Methods: Pre-revision radiographs of 50 patients were interpreted by a senior orthopaedic registrar, supervised by a consultant with a revision THA practice. This acted as the control against which the findings stated on the radiologist's report of the same radiograph were compared. Signs of failure were categorised into loosening, bone lysis and polyethylene wear.
Results: Comparison to previous radiographs was performed by radiologists in only 42% of cases. Fixation type (cemented/uncemented) was stated in the radiologists report in only 2 cases (4%) and was correct in one. Acetabular component loosening was missed by radiologists in 24% of cases and femoral component loosening in 55%. Radiologists missed osteolysis on the acetabular side in 67% of cases and on the femoral side in 57%. Radiologists failed to report polyethylene wear in 93% of cases.
Discussion: The radiographs reviewed contained definite evidence of failure, being pre-revision radiographs. Vital information, essential in prompting specialist review, was lacking in the radiologists' report and primary care physicians using these reports for radiographic follow-up would have been falsely reassured that all was well with the prosthesis in a significant number of cases. We feel that proposals for primary care based follow-up of THAs that depend on review of radiological reports as a surrogate for specialist review of the radiographs themselves are not safe.

☆ The paper was presented as a podium presentation at the BOA/IOA combined meeting in Dublin, Ireland, in September 2011.

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1. Introduction

Follow-up of total hip arthroplasty (THA) patients is essential. Primarily, it aims to identify failing THAs early to avoid late complex revision due to silent failure.[1] Delayed surgery, with extensive bone destruction, can result in the need for more complex revision surgery with less predictable outcome, and potentially increased cost and length of hospital stay. Surgeons are also keen to follow patients up in order to analyse their own outcomes, for research and audit purposes, to learn about results with specific implants and to provide local outcome data when consenting patients.[2] Of note, failures of the articular surface replacement (ASR) hip prosthesis (DePuy), which was subsequently recalled from the market in 2010,[3] were identified through outcome reports by surgeons as well as through Joint Registry data.

Currently, there is no National Institute for Health and Care Excellence (NICE) guidance on the frequency and duration of follow-up for THA patients. Follow-up arrangements for these patients vary across the UK.[4] The British Orthopaedic Association (BOA) recommends that as the minimum standard THA patients be reviewed by the surgeon within 8 weeks of the operation and that clinical and radiological follow-up should be undertaken at one, 5 and each subsequent 5 years after the operation.[1] The UK National Audit Office Report states that "sixty percent of consultants believe that patients should be followed-up for life".[5]

With increasing numbers of THAs being performed each year, the demand and resources required for follow-up are increasing dramatically. Follow-up of THAs has caught the attention of Healthcare funding authorities (Clinical Commissioning Groups in the UK) who have, in some cases, removed funding for follow-up consultations in an attempt to decrease costs and to increase capacity for new patient attendances thus reducing new patient waiting times. [6] There has thus been an emphasis on shifting follow-up care from the secondary care setting to the primary care setting.[7] Hospitals in the UK have also been subject to financial penalties if their new to follow-up ratios are too high. Some have responded to this by discharging THA patients from further follow-up as early as 6 weeks post-surgery. Primary care physicians have been encouraged to take on the burden of reviewing THA patients clinically and radiographically. Review of radiographs is a very important part of follow-up of joint replacements. However, primary care physicians are not trained to interpret these radiographs and in any case do not usually have access to them, and they are therefore heavily reliant on the radiologist's report of such radiographs.

Regular exposure to inadequately reported THA radiographs in our routine clinical practice prompted us to perform this study (Fig. 1).

We looked at the quality of radiographic reports by comparing the radiologist's report of a radiograph to the findings of senior orthopaedic surgeons with a special interest in revision surgery who reviewed the same radiographs and whose findings acted as the control. The aim was to determine the accuracy and usefulness of the radiologist's reports as a method of radiographic follow-up of THAs.

2. Patients and methods

The immediate pre-revision anterior-posterior pelvic radiographs of a consecutive series of 50 patients, who had

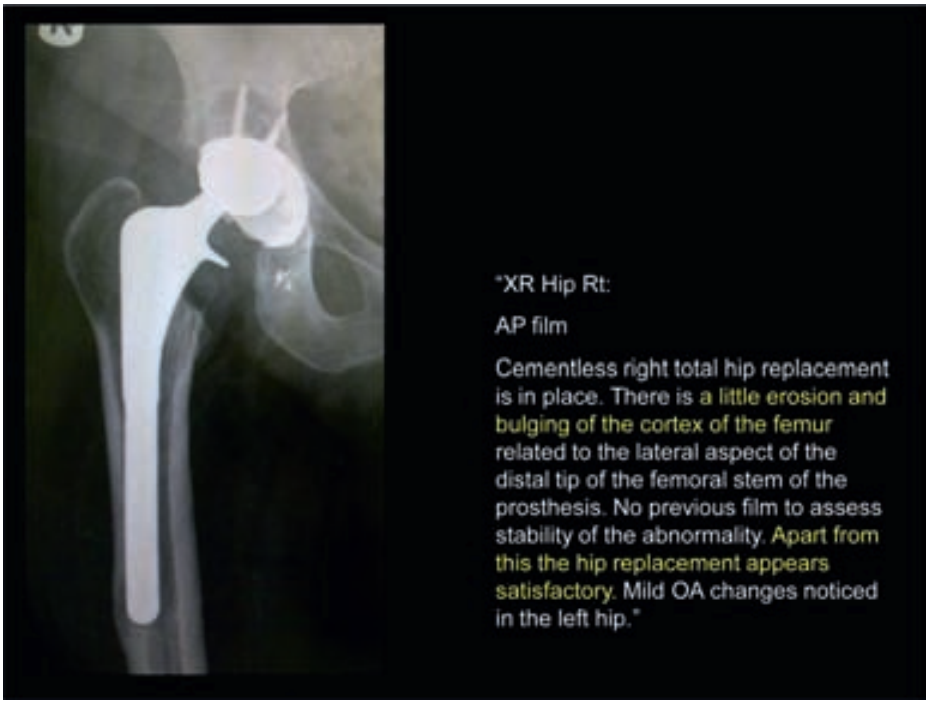

Fig. 1 – An example of a radiograph and corresponding report, which prompted us to perform this study. The radiograph shows clear signs of a failed THA with osteolysis and catastrophic polyethylene wear, however there is no reference to this in the report.

undergone revision surgery in 2 hospitals, were examined by a senior orthopaedic registrar (ST6), supervised by a consultant with a revision total hip replacement practice, and compared to the findings of the corresponding consultant radiologist's report. The radiologists were an unselected mixed group of general and musculoskeletal radiologists. To exclude bias, the surgeons reviewed the radiographs independently, prior to reading the corresponding radiologist's report, and did not have access to any patient details. In addition, a discrepancy between the surgeon's and radiologist's interpretation was only validated if both surgeons independently agreed there was a discrepancy. Orthopaedic surgeons analysed the radiographs looking for signs of loosening, osteolysis and polyethylene wear (Table 1). Previous radiographs were used for comparison purposes as this is common and good practice. Fixation and type of prosthesis was documented. Radiographic loosening of cemented hips were defined as definitely loose, probably loose and possibly loose according to the criteria described by Harris.[8] Uncemented hips were analysed according to Engh's criteria of osteointegration.[9]

Patients who had undergone 2-stage revision for infection, and patients whose previous radiographs or reports were not available were excluded from the study.

3. Results

The mean age of the patients whose radiographs were studied was 74 (range 40–91 years). The male to female ratio was 1:2. There were 26-cemented THAs, 13 uncemented THAs and 11 hybrid THAs.

Comparison to previous radiographs: This essential step in assessing THAs, was performed by the radiologists in only 42% of cases.

Fixation type (cemented/uncemented) was mentioned in only 2 cases (4%) and was correct in only one case.

Loosening: Loosening of the acetabular component was reported by surgeons in 21 out of 50 cases (42%), but reported by the radiologists in only 16 cases (false negative rate of 24%). Radiologists reported a loose acetabular component, when none was present, in 4 cases. Sensitivity and specificity for detecting a loose acetabular component was 76% and 86% respectively. Failure by radiologists to report loose femoral components followed a similar trend, with a false negative rate of 55%. Only 2 cases were over-reported by radiologists. Sensitivity and specificity was 46% and 95% respectively (Fig. 2).

Osteolysis: This was missed by radiologists on the acetabular side in 67% of cases and on the femoral side in 57% of cases. Sensitivity for detecting osteolysis on the acetabular side and femoral side was 33% and 44% respectively (Fig. 3).

Polyethylene wear: This was missed by radiologists in 93% of cases. Sensitivity for detecting polyethylene wear was 7% (Fig. 4).

Table 1 – Accepted equivalent terminology that was sought for in the radiologist reports.

Loosening	"loose", "cup migration", "lucency all around the acetabulum", "rotated cup", "lucency all around the stem", "cement fracture", "subsided or sunken prosthesis"
Bone lysis	"lucency", "bone loss"
Polyethylene wear	"liner wear", "asymmetric position"

4. Discussion

This study has demonstrated alarming omissions in the reporting of radiographs of failed THAs by radiologists. These are the very reports that primary care physicians would receive after requesting radiographs in patients with hip replacements for routine follow-up or in patients with symptoms from their THAs. This raises particular concerns in follow-up programmes where primary care physicians are going to be largely responsible for follow-up of THAs.

Of the 80,311 total hip replacements performed in England and Wales in 2011, 11% were revision surgeries with the most common indications being aseptic loosening (46%), pain (26%), and lysis (14%).[10] Although these complications may give rise to symptoms, aseptic loosening, lysis and polyethylene wear may also be silent initially and only give rise to symptoms once extensive bone destruction occurs or when the liner has been nearly completely worn. To detect this, some form of imaging is essential and plain radiography, when interpreted accurately, is still the most commonly used method to detect component loosening.[11]

The radiographs reviewed in our series contained definite evidence of failure, being pre-revision radiographs. Despite this, radiologists missed clear signs of failure, and they were particularly poor at identifying osteolysis and polyethylene wear. This study did not aim to ascertain the percentage of patients who were symptomatic at the time of the radiograph, although a vast majority of patients undergoing revision surgery for aseptic loosening would most likely have been symptomatic. This study did not set out to look at the use of radiographs as a screening tool to replace clinical follow-up. Asymptomatic patients, who present with signs of failure on radiographs, would usually be followed-up more closely and if progression occurred, revision surgery would be considered even in the absence of any symptoms. This study focused on the accuracy of radiological reports of primary hip replacement radiographs.

The importance of examining serial radiographs to detect prosthetic failure has been stressed by Pluot et al.[12] For example, areas of bone loss occurring in the first 2 years following surgery may relate to stress shielding, and only be considered pathological if there is progression over time.[12,13] Although review of previous radiographs when looking for evidence of failure is routine amongst arthroplasty surgeons, this was carried out by the reporting radiologists in fewer than half of cases.

The average cost of a follow-up consultation in secondary care in the NHS for THA patients is £83 (EUR 97; USD 132), [14] and that of an antero-posterior hip radiograph is approximately £60 (EUR 70; USD 96). The follow-up of these patients as currently proposed by BOA beyond the one year review, over a 20 year period would cost in the range of £500 to £600 (EUR 583–700; USD 800–960). Revision surgery is expensive, but

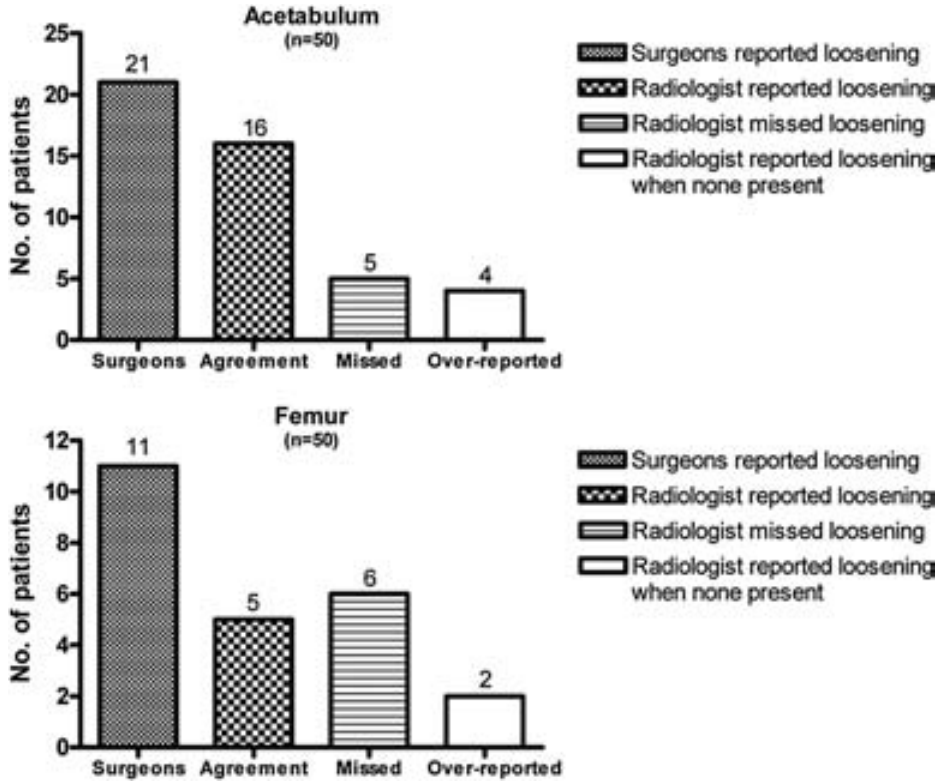

Fig. 2 – Loosening of acetabular and femoral component.

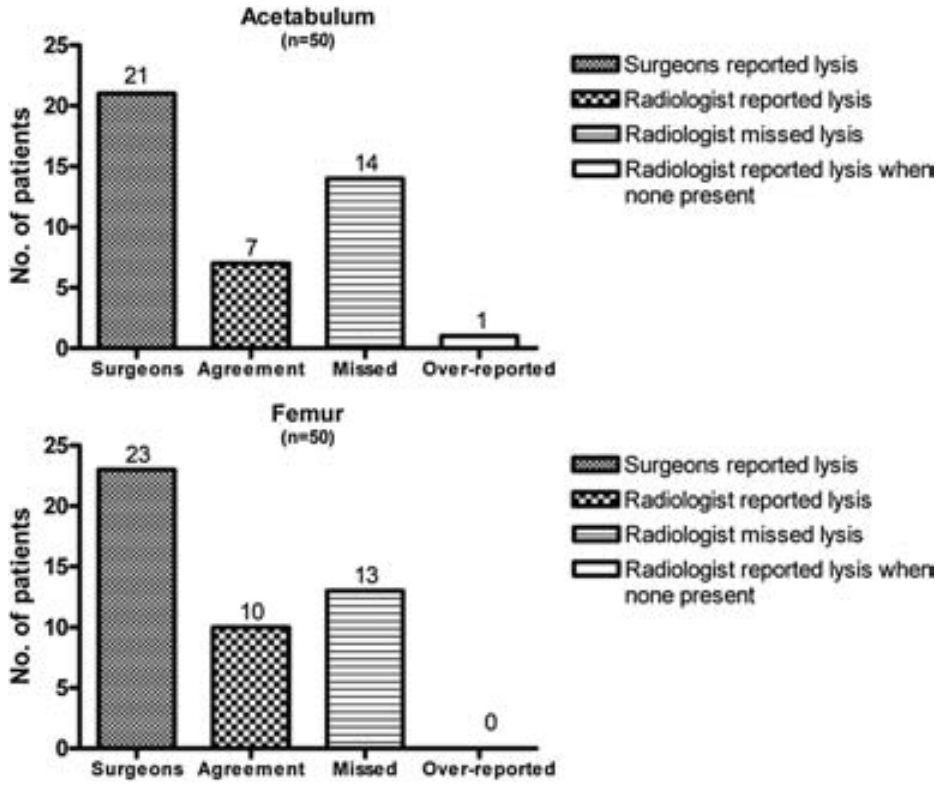

Fig. 3 – Lysis surrounding the acetabular and femoral components.

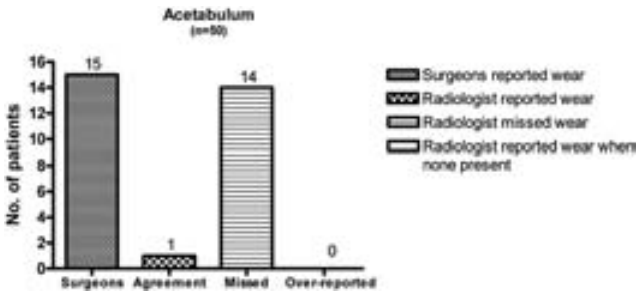

Fig. 4 – Polyethylene wear.

becomes much more so with the use of specialist revision prostheses to deal with greater bone loss. The senior author has dealt with many patients who were discharged from follow-up at an early stage, and who remained asymptomatic until they presented with catastrophic failure and enormous bone loss that required the use of complex reconstructive techniques and more expensive implants than would have been necessary had the failure been identified and treated in a more timely manner.

Our study is limited by the relatively small population size. The qualitative nature of our data poses difficulties in precisely defining terms used by the radiologists in their reports. In addition, there was a mixed group of radiologists reporting these radiographs with no sub-analysis made between general and musculoskeletal radiologists. This, however, represents the current status quo of reporting of such radiographs in most UK hospitals. This study has demonstrated that the dominant problem was under-reporting by the radiologists of important signs of component failure. Although the surgeons' analyses was biased as they knew the radiographs were of pre-revision cases and they were therefore more likely to look for evidence of failure, we believe that the radiographic signs observed were in most cases clear and unequivocal. Infected cases were excluded from our study, as the radiographic findings can be subtle in such cases.

5. Conclusion

We acknowledge that with increasing number of THAs being performed, the issues of cost and optimal method of follow-up arise. Appropriate and cost-effective methods of joint replacement follow-up are needed. However, we feel that solutions that incorporate radiographic follow-up and decision-making based on radiologist's reports of pelvic radiographs are potentially unsafe and may result in some failing hip replacements being missed and some patients being exposed to delayed and more complex surgery. This could potentially be avoided if failing hips were identified early, monitored appropriately and revised in a timely fashion.

Clearly the situation might be different if the radiologists interpreting the radiographs had been trained in the interpretation of post THA radiographs. Our clinical experience suggests that this is not, however, widespread.

We suggest that all primary THAs be followed-up by, or under the guidance of, specialist lower limb arthroplasty surgeons. Appropriate funding for such follow-up is essential. Conventional follow-up is expensive but alternatives exist, such as virtual clinics run by Specialists where follow-up of patients occurs by assessment of annual hip scores and appropriately timed radiographs and also specialist physiotherapists or nurse led follow-up clinics. Both are more cost-effective than conventional follow-up, in which patients are often seen and radiographs arranged more frequently than is necessary because of the limited ability of most NHS hospitals to arrange appointments beyond one year, and the lack of a formal plan for radiographic follow-up.

Whatever method is chosen, radiographs must be accurately interpreted so that correct management decisions can be made. If radiographs are to be routinely reported by radiologists and reports relied upon by primary care physicians to make decisions about THAs, then the reporting radiologists must be appropriately trained and the reports regularly audited for accuracy.

Conflicts of interest

All authors have none to declare.

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Original Article

Effect of duration of symptoms on the outcome of arthroscopic shoulder procedures – Is it a predicting factor?

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Keywords:
Shoulder surgery
Duration of symptoms
Recovery period

ABSTRACT

Purpose: In our study we looked into the effect of duration of symptoms, age and sex of the patients in predicting the outcome of surgery in arthroscopic subacromial decompression.
Type of study: Prospective study – Case series.
Materials & methods: Fifty-one patients who underwent arthroscopic shoulder subacromial decompression procedure were followed up after surgery to assess the effect of duration of symptoms, age and sex on the outcome. Recovery period was assessed and reviewed for any effect by the predisposing factors.
Results: The duration of symptoms did not differ among different age groups and in either sex. The average duration of symptoms in either sex group was nearly equal. The average recovery time was 113 days for men and 125 days for women respectively. Statistically significant correlation was not found among either sex or in different age group in terms of recovery period and the length of symptoms prior to surgery.
Conclusion: This study has identified certain factors predictive like age, sex and duration of symptoms prior to surgery does not have any statistically significant impact on the length of the recovery period and outcome.

1. Introduction

Shoulder problems are a significant cause of morbidity and disability in the general population. The overall prevalence of shoulder pain in the UK population is estimated to be around 7%,[1] rising to 26% in elderly,[2] making it the third most common musculoskeletal presentation to general practice,[3] accounting for 4.2 million days of sick leave in the UK each year.[4]

Shoulder problems can lead to an inability to work and perform basic domestic and social activities as well as leading to serious economic difficulty for affected individuals and their families. Yet, despite this, research into the predictive factors for the prognosis of shoulder conditions remains poor.

Shoulder disorders, of which subacromial impingement syndrome is the most prevalent, have a high occurrence in the physically active population, particularly amongst professional atheletes.[5]

Factors such as age, gender, social class, occupation and duration of symptoms have been looked into in the past for prediction of outcome of surgery for the subacromial decompression and the results are vary variable. Little research has

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been formally conducted assessing any effect that these factors have on recovery time following surgery.[6]

Patients are under pressure for knowing their recovery time for employment, social and community needs. Predicting the recovery time is always challenging for the clinician.

To date there are no such studies available to predict the recovery time and timing of surgical intervention in subacromial decompression, cuff repairs and stabilisation of shoulder joint.

Hence our aim in this study was to assess whether factors like duration of symptoms and timing of surgery in relation to different age groups and sex influences the outcome and aid in assessing the recovery time.

2. Materials and methods

Data was collected from all the patients who underwent arthroscopic subacromial decompression by the senior author over one year period. The senior author has been prospectively following all his patients who underwent these procedures. The details about the data were collected from computer-assisted surgical database. Strict inclusion and exclusion criteria were followed in studying the outcome of the patient.

Patients who had previous surgeries either open or arthroscopic procedures on the same side, patients with pre-existing other shoulder pathology on the same side and patients who underwent any major surgical intervention on the same shoulder were excluded from the study. Patients with inadequate data regarding the duration of symptoms and documentation of recovery time from the surgery were also excluded from the study.

We also excluded patients who were still receiving physiotherapy and post-operative care and not discharged from the clinic.

The duration of the symptom was calculated from the time first patient experienced the symptom to the date till they underwent surgery.

The main primary outcome variable in the study was recovery time.

Recovery period was calculated from the time of surgery to the date of being discharged from the clinic by the senior author and by the physiotherapy department with out any residual complications.

Demographic values like age and sex were taken into account and subsequent analysis was carried out to look into any variation among the outcome.

All the patients were referred by their G.P. to the senior author and were seen in the clinic where a diagnosis was made and planned for surgery. After the surgery, patients were sent to physiotherapy and followed up at 2nd week, 6th week, 3 months, 6 months and one year post op. The recovery time was calculated at the time of discharge of the patient from the clinic.

The senior author performed a total of 261 arthroscopic surgical procedures during the study period. Of these only 51 patients were included in the study after applying the inclusion and exclusion criteria. Patients with full data set available from diagnosis to discharge were included in the methodology and results assessments. There were 26 (51%) men and 25 women (49%). All the patients had made full recovery at the time of final discharge.

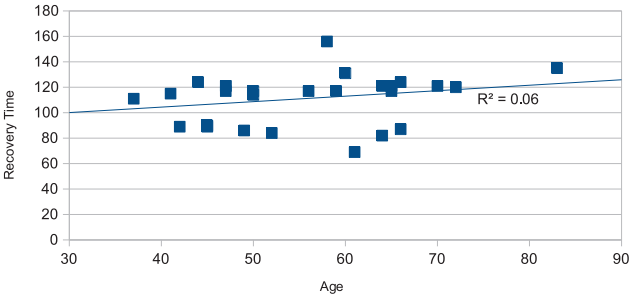

Fig. 1 – Age vs recovery time.

3. Results

The outcome was considered satisfactory if no revision surgery was performed, if the patient had good symptomatic relief from the condition and felt better or much better after the arthroscopic procedure.

The average patient age was 56 years (male-55 and female-57). The average length of symptoms in impingement syndrome cases was 577 days and average recovery time in days was 102 days. The duration of symptoms did not differ among different age groups and in either sex. The average duration of symptoms in either sex group was nearly equal. The average recovery time was 113 days for men and 125 days for women respectively. The recovery time was not significantly affected by the age (Fig. 1) ($r^2 = 0.06$).

No significant correlation ($r^2 = 0.00004$) was also found among either sex in terms of recovery period or the length of symptoms prior to surgery (Fig. 2).

4. Discussion

Conventionally, shoulder joint functional assessment is made clinically by several tests and questionnaire. However, in practice, functional loss can often be difficult to quantify accurately, due to impractical restraints, differences in individual patient expectations and tolerance levels and the difficulty in standardising clinical findings. Disability and post-operative recovery are more often evaluated using subjective

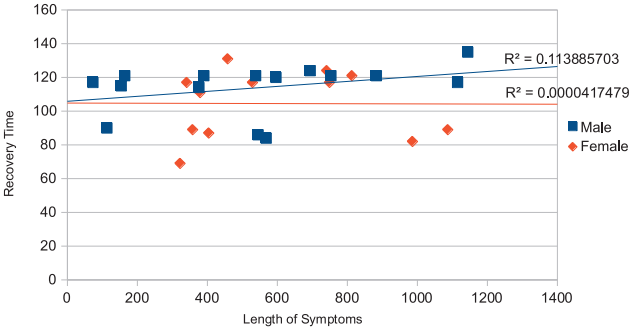

Fig. 2 – Length of symptoms vs recovery time.

measures that assess a patient's ability to function in daily life, thus focussing on patient rather than on the disease.

Several shoulder disability questionnaires and clinical frameworks have been developed over a period of time including measures like Oxford shoulder scores and constant score, which help in assessing the functional status of the shoulder joint.

Very little research has been conducted in identifying and testing the validity and effectiveness of these clinical tools and their role in predicting recovery time.[6]

There are several prognostic indicators associated with each of the outcome measures. Disability, symptom duration and baseline pain level were the only factors to reach moderate to high evidence for predicting outcome in a recent systematic review of cohort of studies.[7]

According to Thomas et al[8] baseline characteristics of the population (gradual onset, duration and severity of symptoms) are the most powerful predictors of the outcome.

The available literature is equally divided regarding the effect of duration of symptoms on the outcome and recovery time in shoulder disorders.

In univariate analysis, after adjusting for treatment, male sex, longer duration of symptoms and gradual onset of symptoms and high baseline pain and disability scores were associated with poor outcome.[9]

In another study by Conroy and Hayes[10] age, side of dominance and duration of symptoms had no effect on outcome measures of primary shoulder impingement.

In the past age has been a significant factor in determining the outcome. Kempf et al[11] reported less satisfactory outcome in patients under the age of 60 years. Romeo et al[9] observed poorer outcome in women above 65 years after cuff repair as compared to men.

Hence in our study we tried to look into the main variable factors like duration of symptoms, age and sex in correlation to the recovery period time, which have been inconsistent in numerous studies.

Our study has limitations due to its relatively smaller cohort and short duration of follow-up. The main finding of the study is that the length of symptoms does not significantly affect recovery time following arthroscopic shoulder surgery for impingement syndrome, rotator cuff repair and stabilisation of shoulder pre-operatively. Recovery period time is also not influenced by either age or sex as seen in some of the other studies.

As in this study only a few variables were explored further studies of similar nature should be attempted for better further understanding of the correlation between recovery time and much wider range of factors, such as socio-economic status, occupation status and co-morbid medical and psychological factors.

A better understanding of the predicting factors on the recovery time following shoulder surgery would be beneficial to both patients and health care professionals.

5. Conclusions

This study has identified certain factors predictive like age, sex and duration of symptoms prior to surgery does not have any statistically significant impact on the length of the recovery period and outcome.

However a larger multicentre prospective studies of similar nature looking into many more variables in assessing the recovery period and outcome of surgery is a topic for future research.

Conflicts of interest

All authors have none to declare.

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Original Article

Modified hemi-hamate replacement arthroplasty

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Keywords:
PIP fracture dislocation
Hemi-hamate arthroplasty
Hamate arthroplasty
Chronic PIP joint injuries
Volar buttress

ABSTRACT

Background: The Hemi-Hamate Replacement Arthroplasty (HHRA) described by Hastings is an excellent option in the management of fracture dislocations of the proximal interphalangeal joints (PIPJ) in the hand. We have noted late development of hyperextension deformity in some patients following HHRA.

Methods: We propose a modification to prevent this deformity following HHRA by reattaching the volar plate by a transosseous suture to the reconstructed volar buttress after the hamate graft is secured to the defect. This modification prevents a late hyperextension deformity.

Results: We reviewed six patients who underwent the modified HHRA. The grafts had united in all patients with an average of 85° of motion at the PIPJ, significant reduction of pain and improvement in grip strength at a minimum follow up of one year. There were no hyperextension deformities.

Conclusions: The modified HHRA for neglected PIP fracture dislocation appears to augment the PIP joint stability following the HHRA procedure and prevents late deformity in chronic cases.

1. Introduction

Hastings proposed a size matched hemicondylar hamate replacement arthroplasty (HHRA) for the unstable PIPJ fracture dislocation.[1] Its clinical application showed a successful outcome for the acute injuries and in fingers where other methods had failed.[2,3] We have noted development of late hyperextension deformity in some patients following HHRA when done for neglected cases and when patients present late (>6 weeks from injury). Hence a modification has been added to the original Hastings procedure by the senior author (BPT). This is a report of the surgical technique and follow-up of patients treated by this modification.

1.1. *Operative technique of HHRA procedure*

Using a volar zig-zag incision, the flexor sheath is exposed and the neurovascular bundles on both sides are identified and protected. The thin flexor sheath comprising C1 and A3 pulleys lying between the A2 and A4 annular pulleys is carefully incised on one side and retracted as a flap. The long flexor tendons are next retracted to one side with a double prong blunt hook to expose the volar plate. The volar plate is incised at its attachment on the small displaced fragments of the middle phalanx and the accessory collateral ligament reflected as a proximally based flap. The collateral ligaments are elevated by sharp dissection from their bony insertions. The PIPJ is cleared of all fibrous tissue avoiding additional damage

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to the articular cartilage on the head of the proximal phalanx and the remaining portion of the articular surface of the base of the middle phalanx. The central slip lying on the mid dorsal aspect of the joint is protected from injury. Any bony remnants attached to the distal edge of the volar plate are incised and removed (If the central slip is adherent, it is carefully released). After the joint is reduced it is gently taken through a full range of motion and held fully flexed for a while to stretch the tight central slip and dorsal extensor expansion. The remaining articular surface of the opposing components of the joint is once again inspected for cartilage damage, since extensive damage of the cartilage makes the hemi-hamate arthroplasty procedure unsuitable and an alternate procedure as a better choice (All of the six fingers selected for HHRA had the articular cartilage of the opposing surfaces of the joint undamaged facilitating completion of the intended procedure). The defect in the volar base of the middle phalanx is then freshened using a burr and made ready for receiving the autogenous hamate graft of the appropriate size. A transverse drill hole is made at the base of the middle phalanx to pass the transosseous suture. The length, breadth and width of the defect in the base of the middle phalanx is measured using a sterile callipers and this is transferred directly on to the hamate to obtain the size matched graft. Turning the hand to face palm down, a 2 cm transverse incision is made over the dorsal aspect of the hamate and a dorsal portion of the distal hamate articular surface is chosen to match the size of the defect as was measured in the middle phalanx. The central ridge on the hamate is taken as the centre of the harvested graft to coincide with the central ridge on the articular surface of the middle phalanx. The segment is delineated, marked and

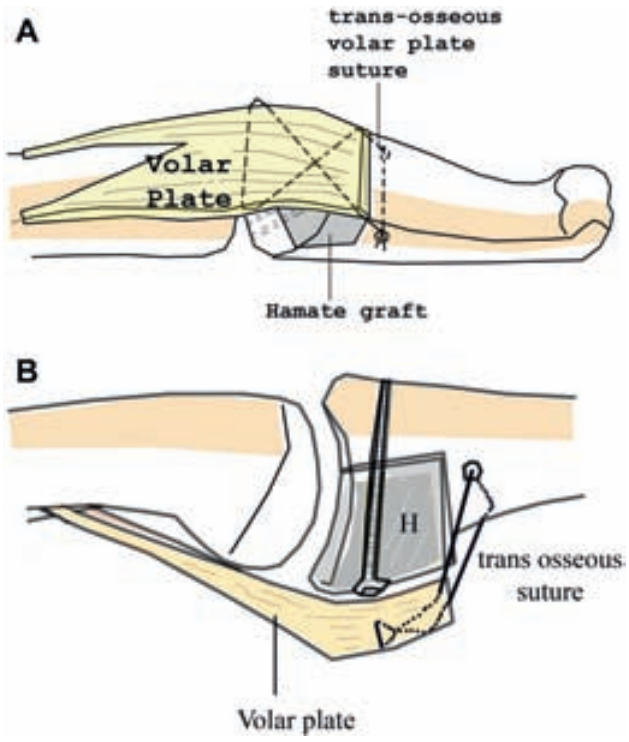

Fig. 1 – (A,B) Line diagrams showing the hamate graft in place and the site of the transosseous hole with a suture anchoring the volar plate to the middle phalanx.

Fig. 2 – Intraoperative photograph of HHRA with volar plate being anchored to the middle phalanx by sutures.

carefully removed with a fine osteotome placed into the volar basal defect of the middle phalanx. Two 1.5 mm mini screws of appropriate length are used to securely fix the fragment. The volar plate is then attached to the middle phalanx with the transosseous 4-0 Ethibond suture. The PIPJ is gently put through a range of motion while avoiding forceful pressure at full flexion and extension. The C1 and A3 flexor pulleys flap is tunnelled under the flexor tendons and sutured to the collateral ligament to cover the implant heads and to serve as a smooth bed for the long flexor tendons. An optional 1 mm K wire may be used to transfix the PIP joint in 30° flexion to avoid any tendency of the joint to sublux in the early postoperative period. The skin is closed and the hand is immobilised with a padded plaster of Paris volar slab stopping short of the distal palmar crease. A dorsal block splint is used and contoured to the 30° of flexion of the PIPJ.

1.1.1. *Postoperative hand therapy*

With the dorsal block splint left in place, active range of motion of the MCP and DIP joints is commenced and supervised daily as an outpatient programme from the end of the 1st week. Sutures and the transfixation K wire if used are removed between the 12th and 14th day and thereafter active flexion-extension of the PIPJ is also encouraged under daily supervision for another seven to 10 days. As comfort improves and confidence in self care grows the patient is then

Table 1 – Details of six patients that presented late and were selected for our modified HHRA.

Patient	Age	Sex	Side	Digit	Duration (weeks)	Range of motion	
						Pre-op	Post-op
1	21	M	L	IF	15	10	100
2	19	M	L	LF	12	20	80
3	41	M	L	MF	8	10	90
4	24	M	L	RF	14	5	90
5	32	M	R	MF	12	10	70
6	34	M	R	IF	14	20	80

Fig. 3 – Pre-op X-rays of a patient with neglected fracture dislocation of index finger PIP joint with loss of volar buttress more than 40% with subsequent subluxation of the PIP joint.

recommended only weekly visits for the next 3 weeks while the daily flexion and extension exercise programme is carried out at home. At the end of 6 weeks from the time of surgery the dorsal splint is removed and light pick up activities are started. The patient is advised to avoid rotary movements of the fingers for another 6 weeks. Review assessments including X-rays of the PIPJ are done every 3 months for a year (Figs. 1 and 2).

2. Patients and methods

We have used this modification preliminarily in six patients presenting late with a stiff and painful finger due to closed PIPJ fracture dislocation. Details are summarised in Table 1. Pain assessment by a visual analogue scale (VAS) showed a mean of 9.17 (range: 8–10). Grip strength evaluated with a Jamar dynamometer averaged 73.3% (range 70–80%) of the opposite side. Anteroposterior and lateral view plain radiographs centred on the PIPJ of the injured finger confirmed the diagnosis and showed the mean loss of volar base of the middle phalanx in the injured finger to be 53% (range between 40% and 60%) Fig. 3. SPSS 11.0 was used for statistical analyses of the results. Wilcoxon signed rank's test was performed to assess the difference between paired variables. A p-value <0.05 is considered statistically significant (Table 2).

3. Results

The wounds in all the patients healed normally without a problem and there was no persistent oedema beyond 6 weeks. Radiographs taken around the sixth month confirmed union of the graft in all the fingers with no apparent absorption of the bone or loss of fixation. One patient wished to have the screw removed and this was done at the end of the first year.

At a minimum follow up of 1year (12 months–30 months) the range of motion at the PIP joints was a mean of 85°. It was an improvement of 72.5° and significant (p-value 0.026). Passive testing in the early and late postoperative period showed no instability in the anteroposterior and mediolateral planes. Pain had reduced considerably to a mean of 1.6 in the postoperative period as assessed using a VAS. The improvement was by a mean of 8 points over the preoperative pain levels of 9.6 using the VAS ($p = 0.026$). Grip strength reached 84.5% of the opposite uninjured hand, an improvement of 17.5% that was significant ($p = 0.024$). Improvements in all these parameters were indicators of good pain relief, stability and range of motion as attained after HHRA.

Table 2 – Pain relief as analysed using a VAS, and grip strength as measured using a Jamar dynamometer.

Patient	Pain (VAS)		Grip strength	
	Pre-op	Post-op	Pre-op	Post-op
1	9	1	70	90
2	10	1	80	100
3	8	2	70	80
4	9	0	75	95
5	10	1	70	90
6	9	2	75	90

Fig. 4 – Follow up films of a modified HHRA showing the graft secured by mini screws and good restoration of the volar buttress.

4. Discussion

Neglected dorsal fracture dislocations of the PIP joint in the hand present as stiff and painful fingers.[4] Plain films reveal a dorsal subluxation of an unstable injury (>40% articular fracture of the P2 base) of the joint with the volar base of the middle phalanx either fragmented and nonunited or rarely malunited. Few management options are available in this situation. Open reduction with K wire fixation,[5] corrective osteotomy with or without bone graft,[6] Eaton's volar plate arthroplasty[7] and PIP joint arthrodesis have been described. The volar plate arthroplasty done on such late cases and for PIP joints results in 31% subluxation or dislocation.[8] The HHRA (Hasting's procedure) is an ingenious procedure to tackle PIPJ fracture dislocations most effectively[1–3] with resultant mobile PIP joint.

In our practise, patients often neglect closed injuries to their hand and wrist and seek attention only when pain and stiffness interferes or prevents work. Fingers with neglected fracture dislocation of the PIP joint characteristically remain slightly swollen and painful with limited range of motion affecting power grip. Plain films often demonstrate comminuted osteoporotic volar fragments at the base of the middle phalanx making open reduction and internal fixation questionable in addressing all aspects of the problem, i.e., stable reduction, mobility and pain relief. Volar plate arthroplasty has a high failure rate[8] and does not provide adequate stability for its application in the hands of manual labourers. A sound PIPJ fusion that abolishes pain is ideal and largely accepted by semiskilled labourers, but for other individuals that need a dextrous hand with as much small joint mobility, PIPJ fusion is accepted very reluctantly.

We have used the HHRA with our modification – the anchoring of the volar plate to the middle phalanx with a nonabsorbable suture passed through bone in all of the six patients in this series. This way of securing the volar plate

Fig. 5 – Range of flexion and extension attained after the modified HHRA.

firmly to the anterior portion of the PIPJ reinforces the volar stability and prevents the hyperextension deformity. With the C1 and A3 pulleys also sutured on top of it smoothens the contour of the bed for free excursion of the overlying flexor tendons. It is also effectively an advancement of the volar plate that can prevent secondary hyperextension deformity. The modifications were added when a patient who had HHRA developed a hyperextension deformity of the PIPJ 6 months after the procedure. On exploration, it was noted that volar plate remained unattached to the middle phalanx base and have contributed to the deformity.

Secondary hyperextension after HHRA can also presumably result from a persistently tight or contracted extensor apparatus, or an undersized graft that allows PIPJ dorsal subluxation to recur with loss of flexion and increasing extension. In acute PIPJ fracture dislocation where HHRA is done the extensor apparatus is not contracted at the time of the procedure and so the causes leading up to postoperative PIPJ hyperextension may be predominantly skeletal (i.e., an undersized graft), whereas in neglected or chronic cases the PIP deformity *per se* allows for adaptive contracture of the extensor apparatus, mainly the central slip and dorsal capsule. Therefore it is also important that in neglected cases the extensor apparatus is gently stretched intraoperatively by putting the digit through a full range of flexion and extension after the initial operative reduction and then again after the hemi-hamate graft is positioned into the volar defect. We opine that our modification of HHRA (Hastings' procedure) for neglected PIPJ fracture dislocations is a valuable addition to the vital surgical steps required in the surgical correction of the problem, and in preventing late hyperextension of the joint while achieving significant pain relief, increased range of digital motion and improved grip strength of the hand (Figs. 4 and 5).

Conflicts of interest

All authors have none to declare.

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Original Article

Titanium elastic nail fixation for clavicular fractures in adults

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Keywords:
Clavicle fracture
Midshaft fractures
Displaced fracture
Titanium elastic nail

ABSTRACT

Objectives: Clavicular fractures account for 2% of all fractures, and more than 80% involve the middle third of the clavicle. Various modalities of treatments have been explained for the same in literature, including nonoperative and operative. Plate fixation has been associated with many complications, whereas nonoperative associated with delayed union, nonunion and mal union.

We report case series treated with Titanium elastic nail to fix the displaced midclavicular fractures without comminution.

Materials and methods: 20 patients with midclavicular fractures without comminution were included for the study. All were male patient with a mean age of 32.05 years (range 24–40 years). The mean course of the disease was 4 days. Patients were followed up at an interval of 2, 6, 12 weeks till fracture union and Constant Score was used to assess the disability of the upper arm. Fracture reduction and healing were followed up by X-rays to analyze internal fixation with the titanium elastic technique.

Results: All patients were followed up till the fracture union with mean of 4.5 months. The mean bone union time was 12.45 weeks (11–14 weeks). The Constant Score of 94.61 was attained at the latest follow-up. None of the patients had any complications. The anatomical reduction, functional recovery and appearance were satisfactory in all patients.

Conclusion: The treatment of adult midclavicular fractures with Titanium elastic nail provides adequate fixation, faster recovery with early return to normal function.

1. Introduction

The clavicle provides the junction between the chest and the upper limb, so it plays an important role in the whole function of the shoulder girdle. Morphologically, the clavicle normally presents a characteristic S-like shape resulting from the junction of two opposite curves at the level of the midshaft. The bone is thinner and consequently weaker at this junction, which is why most fractures occur at this level (Tables 1 and 2).[1]

Fractures of the clavicle are common, and account for 2–15% of all adult fractures and 33–45% of all injuries involving the shoulder girdle. The midshaft is the most frequently affected site, encompassing 69–82% of all clavicle

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Table 1 – Demographic and clinical characteristics of patients treated with Titanium elastic nail.

Characteristics	No.
Mean age	32.05 years
Sex	
Male	20
Female	0
Clavicle	
Right	13
Left	7
Cause of injury	
Road traffic accident	12
Fall	8
Classification	Allman – Group 1
Reduction techniques	
Closed reduction	12
Open reduction	8

fractures, and most fractures that occur in the midshaft are displaced.[1]

In young adults, these fractures are usually related to sports or vehicle accidents, whereas in children and elderly, they are usually related to falls.[2] In general, clavicle fractures are treated conservatively and have a variable outcome. Hill et al and Robinson et al reported that nonoperative treatment of midclavicular fractures leads to subjectively, clinically, and radiographically unsatisfactory results in 10–30% of patients. Hill et al showed that displacement of more than 20 mm resulted in 15% nonunion and 18% of the patients had thoracic outlet syndrome following union.[3] Hence, more recently, there has been a trend toward surgical fixation. The gold standard for the surgical treatment has been open reduction and plate fixation through a large incision.[4] However, surgical procedures using plate fixation have shown major complications such as hematoma, infections, implant failures and nonunion.[5]

Intramedullary fixation has emerged as a promising alternative to traditional open reduction and internal plate fixation.[6] Advantages of this minimally invasive treatment option include maintaining the fracture hematoma and keeping the periosteum intact, which positively influences bone formation and improves cosmetics owing to the small incisions used.

Recently, Jubel et al[7] introduced a new intramedullary nailing technique in which a single Titanium elastic nail is inserted in an antegrade manner from the sternal end of the clavicle to fix those fractures. He reported fewer complications and a higher rate of fracture healing than those previously reported with the use of rigid intramedullary implants.

The aim of this study was to report the results of treating displaced midshaft clavicle fractures with Titanium elastic nail in adults.

Table 2 – Clinical outcomes of patients treated with Titanium elastic nail.

Outcome	Mean
Duration of follow-up in months	4.5 months
Healing time in weeks	12.45 weeks
Final Constant Score	94.61
Complications	Nil

2. Material and methods

A retrospective review of 20 patients who underwent surgery for displaced midshaft clavicle fractures and treated with Titanium elastic nail were carried out. The patients' data were obtained from the patients' case notes, radiographs, and clinic letters.

We used the Allman classification for clavicular fractures.

2.1. *Inclusion criteria*

Age group of 20–50 years
Diaphyseal midshaft, non-comminuted displaced clavicle fractures
Fractures with imminent skin perforation
Fracture with less than 1 week old.

2.2. *Exclusion criteria*

Patients with proximal or distal fractures
Presence of associated injury – Floating shoulder
Pathological fractures
Open fractures
Brachial plexus injury
Comminuted fractures.

All the patients were followed up at an interval of 2, 6, 12 weeks till fracture union and all were subjected for both clinical and radiological evaluation of fracture union at regular follow-up. We used the Constant Score for functional outcome at latest follow-up.

3. Surgical techniques

After general anaesthesia, patients were placed on radiolucent table in beach-chair position with folded towel under the affected shoulder and injured extremity prepared and draped from midline to upper arm. All patients received single dose of intravenous antibiotic as prophylactic dose. The image intensifier and monitor are placed on the opposite side of the operating table.

A horizontal skin incision (Fig. 4.) of 1–1.5 cm was made 1 cm lateral to the sternoclavicular joint and incision was deepened till bone to separate subcutaneous fat, platysma and pectoral fascia. The entry point was made with bone awl or drill bit and Titanium elastic nail of appropriate size (usually 2.5–3 mm) was mounted on Jacob's chuck and inserted into the medullary canal from the sternal end (Fig. 1). Attempt was made to close reduce the fracture with reduction performed percutaneously by means of towel clip (Fig. 2). If closed reduction failed, then a separate horizontal incision was given at fracture site to ease the reduction. Thus the nail was passed from sternal end across the fracture site till 1 cm from lateral end of clavicle under the fluoroscopic control (Fig. 3). The nail was cut flush to the entry point in order to minimize soft tissue irritation.

All patients were put in arm pouch post-operatively with early gentle mobilization when pain allows. The arm pouch

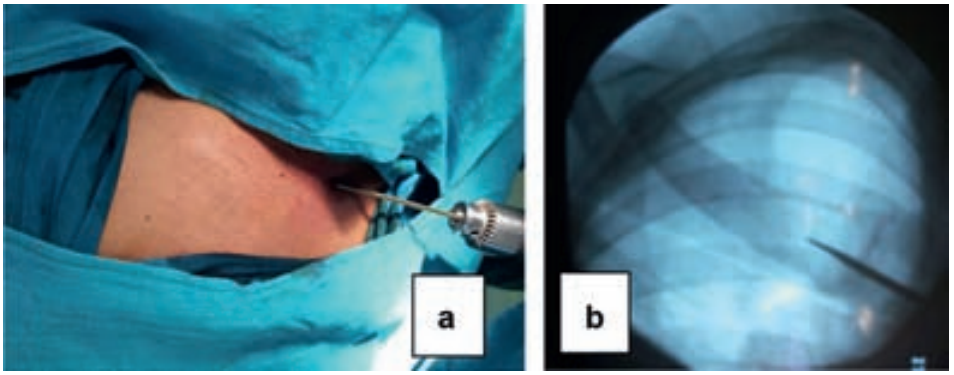

Fig. 1 – (a), Titanium elastic nail being inserted into the medullary canal from sternal end. (b), Intraoperative fluoroscopy after the tip of the Titanium elastic nail in the medial end of clavicle.

was discarded at 4 weeks post-operatively and active-assisted exercises were started. Overhead activity and lifting heavy weight object restricted for 6 weeks.

4. Results

A total of 20 patients met with inclusion criteria. All were male patients with a mean age of 32.05 years (range 24–40 years). 12 patients had road traffic accident and 8 patients had fall as cause for fractures. Of these 20 patients, 13 had fracture on right side while 7 had fracture on left side (Fig. 5). Surgery was performed at mean of 4 days after the injury.

Closed reduction was attained in 12 patients while open reduction was required in 8 patients.

All patients were followed up till the fracture union with mean of 4.5 months. The mean bone union time was 12.45 weeks (11–14 weeks) without any additional procedures (Fig. 6). All patients had satisfactory function with the mean Constant Score of 94.61 was attained at the latest follow-up.

There were no cases of infection, nonunion, implant failure, prominent implant under skin, perforation of lateral end and hypertrophic scar. No shoulder asymmetry was observed in follow-up.

The anatomical reduction, functional recovery and appearance were satisfactory in all patients.

5. Discussion

In most non-displaced clavicular fractures, good functional results can be obtained with nonoperative treatment.[8] Displacement of more than 1 cm or comminution leads to inferior results if treated nonoperatively.[8] Unsatisfactory results in one-third of cases was reported by Hill et al[3] and in a systematic review the rate of nonunion was found to be 15%.[8]

Several options are available for the surgical treatment of clavicle shaft fractures, including plating and nailing. Plating is the most commonly used surgical treatment; however, plating requires relatively extensive periosteal stripping, which may increase destruction of the blood supply at the fracture site, thus hindering fracture healing. Stress shielding produced by rigid plates can lead to an 8% refracture rate after plate removal.[5] Surgical time is considerable, and infection rates of up to 18% have been reported.[5]

Due to the high complication rate with plate fixation, such as soft tissue infection, implant failure, nonunion, and poor cosmetic appearance of the incision,[5] it is advisable to use intramedullary nails[7] in midshaft diaphyseal displaced fractures without comminution.

Titanium elastic nail provides fixation that is more consistent with the physiologic bone structure to permit early functional exercise, leads to faster functional recovery,

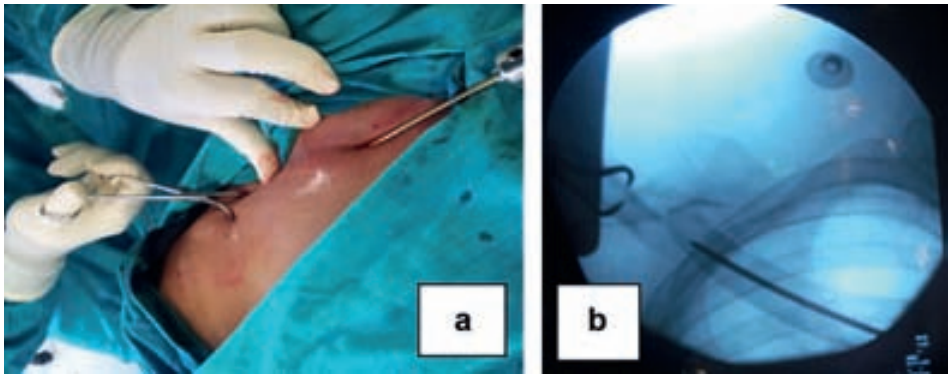

Fig. 2 – (a), Percutaneous reduction of fracture using towel clip. (b), Titanium elastic nail passed across the fracture site under fluoroscopy.

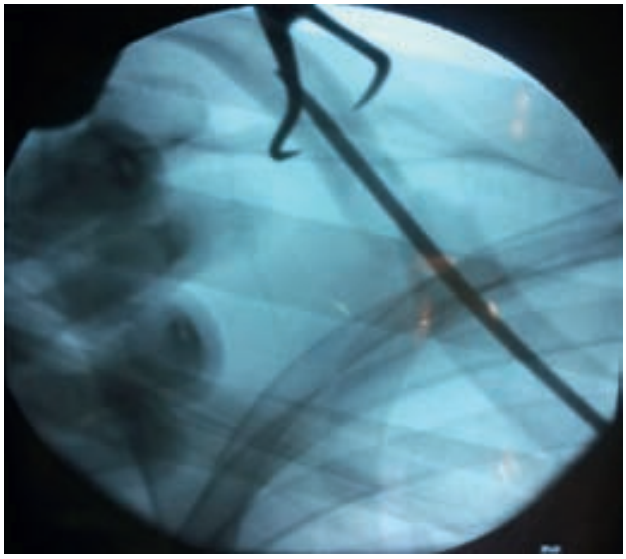

Fig. 3 – Titanium elastic nail passed till lateral end of clavicle under fluoroscopic control.

provides early pain relief and avoids the complications associated with longer operating time, periosteal stripping and other potential benefits of this technique include smaller incision, minimal periosteal stripping.[9] When placed, Titanium elastic nail provides 3 points for support within the medullary canal to effectively control rotation, angulation and shortening of the fragments.

Jubel et al[7] concluded from his treatment of small groups of patients with clavicle fractures that elastic stable intramedullary nailing (ESIN) is a minimally invasive surgical technique that leads to excellent functional and cosmetic results.

We evaluated 20 patients who were treated with Titanium elastic nail at an average follow-up of 4.5 months. All patients showed union of fractures and there was no shortening of clavicle. The mean time for fracture union in our series was 12.45 weeks. These results are superior to the available results in the literature. Chen et al[10] showed a significantly shorter time to union with the Titanium elastic nail group. They showed faster functional recovery with greater patient satisfaction with cosmoses and overall outcome in the Titanium

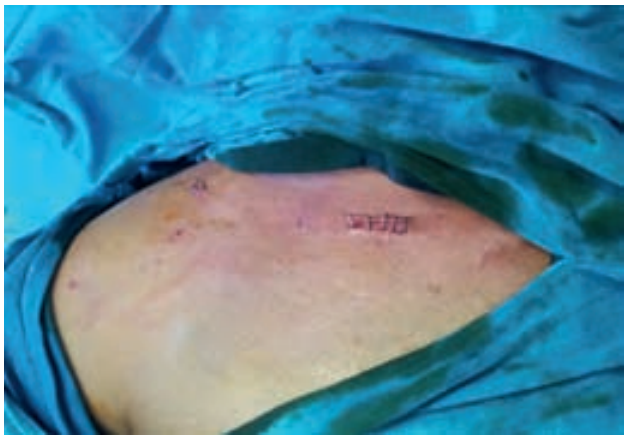

Fig. 4 – Small size of skin incision for nail entry.

Fig. 5 – Pre-operative radiograph showing displaced midshaft fracture clavicle.

elastic nail group. Mueller and colleagues[11] used Titanium elastic nail to treat 32 displaced midclavicular fractures. In that series, with follow-up ranging from 1 to 5 years, nonunion was not observed; however, 12 clavicles healed with a shortening of more than 5 mm. Jubel and colleagues[7] reported only 1 case of nonunion in a series of 62 midclavicular fractures treated with Titanium elastic nail with mean follow-up of 3.5 years.

We did not found any difference in the union rate among the closed reduction and open reduction group.

The final Constant Score was 94.61 attained at the latest follow-up which was comparable to the available literature.[11]

The better results of Titanium elastic nail might be attributed to the less soft tissue dissection and small incision used for nail insertion. Other complications of plate fixation, such as soft tissue infection, hematoma, or implant breakage are uncommon with the use of a titanium nail. In our study, we found no complications with none of the patients had any additional procedure or any symptoms around the shoulder joint. These complications minimized by appropriate size of nail diameter, proper placement of nail at lateral end, sufficient nail left at sternal end with good burial of nail under the

Fig. 6 – Post-operative follow-up radiograph showing union of fracture with restored clavicle length and alignment.

skin and supervised physiotherapy with good patient compliance.

Technical points to be considered while doing Titanium elastic nail.

1. The diameter of nail should be correctly determined before insertion.
2. The insertion point to be from sternal end as this side has wider diameter.
3. The nail long enough to reach the lateral end of the clavicle while leaving 1 cm to prevent penetration and flush with the bone at sternal end to prevent irritation.
4. Whenever closed reduction fails, open reduction should be planed.
5. The entire procedure should be done under fluoroscopic control.

6. Conclusion

The treatment of closed displaced isolated midshaft clavicular fractures in adults with Titanium elastic nail provides adequate fixation, high union rate, faster recovery with early return to normal function and a better cosmoses.

Conflicts of interest

All authors have none to declare.

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Original Article

Reliability of tests for proprioceptive sensation of the knee

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Keywords:
Proprioception
Knee
Anterior cruciate ligament

ABSTRACT

Background: A number of tests are described in the literature to know the proprioreception of the knee joint. There is no report of testing the reliability/ superiority of one test over the other. The present prospective study was designed to evaluate the accuracy and consistency of various tests in determining the proprioceptive sensation of the knee joint.

Methods: Proprioceptive sensation was tested in the normal knees of 50 patients. Eight commonly described tests: active reproduction of passive positioning (ARPP); threshold for detection of passive movement (TDPM); single-leg forward-hop test (SLHT); single-limb standing test (SLST) eyes open (EO): reproduction of standing position (distance error); SLST EO postural sways; SLST EO balance acts (BA); SLST eyes closed (EC): postural sways; and SLST EC balance acts were performed at day 0, 1.5 months, 3 months, 6 months and 1 year. The mean values (±SD) of all subjects for each test for each visit were calculated.

The consistency of each test was assessed by calculating Cronbach's alpha for the five visits. The tests were graded amongst each other in terms of consistency and reliability on the basis of the value of Cronbach's alpha.

Results: The mean age of the patients included in the study was 24.56 ± 5.386 (range 18–43 years).

All the tests except SLST EO balance acts were observed to be of good consistency and reliability (Cronbach's alpha >0.7).

Conclusion: Seven tests (ARPP, TDPM, SLHT, SLST EO postural sways, SLST EO reproduction of standing position; SLST EC postural sways; and SLST EC BA) were consistent and reliable. One test (SLST EO BA) was found to be unreliable for the assessment of proprioception of the knee joint.

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1. Introduction

Proprioception is the sensory modality that encompasses the sensation of joint position and joint motion.[1] Loss of proprioception in a knee with a deficient ACL is well documented.[2,3]

The clinical tests of proprioception that have been commonly used in the literature are:

1. Single limb standing test eyes open: postural sways.[4]
2. Single limb standing test eyes open: compensatory movements (balance acts).[4]
3. Single limb standing test eyes open: reproduction of standing position (distance error).[5]
4. Single limb standing test eyes closed: postural sways.[4]
5. Single limb standing test eyes closed: compensatory movements (balance acts).[4]
6. Active reproduction of passive positioning.[6]
7. Threshold for detection of passive movement.[6]
8. One leg forward hop test.[7]

Despite their common use in clinical practice there is lack of knowledge regarding the reliability/ superiority of one test over the other. The present prospective study was designed to evaluate and compare the accuracy and consistency of these eight commonly described tests of proprioception for knee joint.

2. Materials and methods

The contralateral normal knees of 50 patients undergoing ACL reconstruction tested for the proprioceptive sensation in the normal knee using eight tests (ARPP, TDPM, SLHT, SLST EO postural sways, SLST EO BA; SLST EO reproduction of standing position; SLST EC postural sways; and SLST EC BA). The patients were evaluated periodically, at one day prior to surgery of the contralateral knee labelled as day 0, and after the surgery at 1.5 months, 3 months, 6 months and 1 year interval. For arriving at a particular value of each test, the test was performed five times by the same investigator and the mean of the five values was taken as the final value for that visit.

The mean value (±SD) of all the subjects of each test for each visit was calculated. The consistency of each test was assessed by calculating Cronbach's alpha for the five visits. The tests were graded amongst each other in terms of consistency on the basis of the value of Cronbach's alpha. The test with the value of Cronbach's alpha less than 0.7 was declared as unreliable.[8,9]

3. Results

The mean age of the patients was 24.56 ± 5.386 (range 18 to 43 years). Out of the total 50 subjects, the tests were performed in the right knee of 27 participants (all right dominant) and in left knees of 23 subjects (2 left dominant) because the contralateral knees of all the patients were ACL deficient knees.

The values of Cronbach's alpha (Table 1) in descending order for the eight tests were: SLST EC BA (0.968) > ARPP (0.948) = SLST EC Sways (0.948) > TDPM (0.897) > SLHT (0.874) > SLST EO DE (0.851) > SLST EO Sways (0.849) > SLST EO BA (0.646).

Based on cut off value of 0.7 for Cronbach's alpha for consistency and reliability, all the tests except SLST EO BA were observed to be of good consistency and reliability.

4. Discussion

Proprioception is an important sensation of the knee, which gets altered in various knee pathologies including ACL and PCL deficiencies. Mechanoreceptors, alongwith muscle spindles for the joint proprioception, have been found in the

Table 1 – The mean values of the various tests observed at different time intervals are given.

	ARPP (Degrees)	TDPM (Degrees)	SLHT (cm)	SLST EO Sways	SLST EO BA	SLST EO DE (cm)	SLST EC Sways	SLST EC BA
N (Day 0)	50	50	50	50	50	50	49	49
Mean ± SD (range)	1.700 ± 0.565 (0.8–3.4)	1.316 ± 0.277 (1.0–2.0)	130.3 ± 26.5 (22–170.7)	0.148 ± 0.184 (0–6)	0.024 ± 0.077 (0–0.4)	0.642 ± 0.199 (0.2–1.0)	2.44 ± 1.03 (0.8–4.8)	1.253 ± 0.792 (0.0–3.4)
N (1.5 mon)	48	48	–	48	48	48	43	43
Mean ± SD (Range)	1.896 ± 0.601 (1.0–3.8)	1.233 ± 0.231 (1.0–1.8)		0.079 ± 0.135 (0–0.6)	0.004 ± 0.029 (0–0.2)	0.642 ± 0.186 (0.3–1.1)	2.30 ± 1.00 (0.4–4.4)	1.084 ± 0.619 (0.0–2.4)
N (3 mon)	49	49	–	49	49	49	47	47
Mean ± SD (Range)	1.767 ± 0.578 (0.6–3.8)	1.216 ± 0.223 (1.0–1.8)		0.094 ± 0.174 (0–0.8)	0.004 ± 0.029 (0–0.2)	0.649 ± 0.227 (0.2–1.6)	2.39 ± 1.00 (0.4–4.8)	1.187 ± 0.647 (0–2.6)
N (6 mon)	50	50	44	50	50	50	48	48
Mean ± SD (Range)	1.732 ± 0.494 (1.0–3.6)	1.192 ± 0.181 (1.0–1.8)	136.4 ± 19.5 (94.3–174)	0.072 ± 0.150 (0–0.6)	0.008 ± 0.040 (0–0.2)	0.628 ± 0.143 (0.3–0.9)	2.30 ± 0.84 (1.0–4.6)	1.242 ± 0.673 (0.2–3.2)
N (12 mon)	49	49	47	49	49	49	47	47
Mean ± SD (Range)	1.702 ± 0.460 (0.8–3.6)	1.x ± 0.180 (0.8–1.8)	136.4 ± 22.2 (70–177.7)	0.049 ± 0.139 (0–0.6)	0.008 ± 0.040 (0–0.2)	0.598 ± 0.145 (0.3–0.9)	2.25 ± 0.77 (1.0–4.6)	1.196 ± 0.608 (0.2–3.0)
Cronbach's alpha	0.948	0.897	0.874	0.849	0.646	0.851	0.948	0.968

cruciate ligaments, thus reinforcing the role of proprioception in the knee joint functioning.[1] Moreover, the failure to regain pre-injury functional activity after ACL reconstruction is mainly thought to be related to lack of proprioception in ACL reconstructed knees. [7]

There are a few studies that have evaluated the proprioceptive sensation of the knee by different methods. Reider et al reported that TDPM was a more reliable method than reproduction of joint positioning for testing the proprioception before and after ACL reconstruction.[10] Boerboom et al also observed that the TDPM is a reliable and valid way to measure proprioception.[11] However, Pap et al observed that measurements of threshold levels of detection of passive movement alone were not suitable for the evaluation of proprioceptive loss in ACL deficiency.[12]

Sekir et al reported good reliability of the ARPP and SLST EC BA tests for the study of proprioception of ankle joints.[13] Birmingham assessed proprioception of knee joint using 4 tests: SLST EO BA, SLST EC BA, hop distance on SLHT, and lastly SLST EO BA after landing from maximal hop and reported all of them to be reliable.[14] In our study we did not evaluate the SLST EO BA after landing from maximal hops. Of the remaining three tests, SLST EC BA and SLHT were found to be of good reliability whereas the SLST EO BA was not found to be reliable in our study, which is in contrary to the observation of Birmingham.[14]

Some of the participants in our study could not present themselves on all the study visits, thus at some of the visits the number of participants was less than 50. However, the loss of those visits did not significantly affect the final calculation of Cronbach's alpha as the loss of the visits was statistically insignificant. In this study, we combined the values of proprioception recorded with different tests in one group only rather than separating them into two groups of dominant and non-dominant knees as the absolute values for each test on different time intervals for the same knee will remain constant and the aim of the present study was to demonstrate the consistency of a test on the same knee at different time intervals rather than comparing the values of the tests in the normal knee and the contralateral knee.

In conclusion, the results of this study suggest that the seven tests (ARPP, TDPM, SLHT, SLST EO postural sways, SLST EO reproduction of standing position; SLST EC postural sways; and SLST EC BA) were consistent and reliable for clinical assessment of proprioception. Only the one remaining test (SLST EO BA) was not found to be reliable for the assessment of proprioception.

Conflicts of interest

All authors have none to declare.

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Comment

Continuing professional development in Trauma and Orthopaedic Surgery

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1. Introduction

Across the world training programmes in Trauma and Orthopaedic Surgery have been developed to produce surgeons capable of safe entry into the local workforce. However, no such programme delivers specialists capable of managing the full range of orthopaedic conditions from day one, and none arms the newly qualified surgeon with the knowledge and skills that will suffice for a lifetime of practice. Fellowships taken after the end of a training programme can significantly increase specialist capability and these are essentially further periods of formal training. Beyond these, surgeons keep up to date and fit to practice by involving themselves in Continuing Professional Development (CPD), and by the same mechanism they improve standards by focused learning in areas that are most relevant to their own, often unique, practice profile. CPD isn't therefore just about keeping up to date with the latest research by reading a journal (or the abstracts in a journal, or the occasional abstract that looks interesting and relevant) but it concerns the moulding of knowledge, skills, attitudes and behaviours to keep ones practice safe, up to date and of the highest possible standard.

2. Continuing professional development programmes

Thus a CPD programme is highly personal, as what is relevant to one surgeon may not be relevant to another working in the same department. What is relevant to one surgeon in one year may not be relevant the following year. What a surgeon identifies as a learning need in one year may be the acquisition of new knowledge (learning about new knowledge concerning the metabolic response to trauma and monitoring blood parameters of polytrauma patients as a tool to help decide when it is safe to operate, for example). The next year it may be a skill (surgical technique for a new implant that replaces one that has been used for many years). Concurrently a run of complaints may have led to one identifying, or being advised, that work needs to be done on consultation skills and interacting with patients and managers. It follows therefore that one cannot simply participate in a generic CPD programme and expect this to deliver everything needed to keep up to date and fit to practice (though such programmes may at least keep one fully informed of new knowledge across the speciality).

A CPD programme is unique to the individual and will involve learning across a range of activities including journal reading, attending meetings, discussion groups with peers, practical workshops, web-based activities and so on. Ones needs will vary from year to year and, to work best, some planning needs to be done to get the most out of CPD.

3. Planning continuing professional development

In order to make the most efficient use of ones time CPD should best be planned. Some surgeons are very good at subconsciously noting, as they go along, areas in which they need to develop and then subscribing to learning that address their needs both in developing their practice into new fields and techniques, and keeping them fully conversant with current concepts in their routine work. However, there is a natural tendency to focus on areas that are of particular interest and neglect those that seem mundane, or those

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elements of ones practice that one would give up at the first opportunity. It is dangerous to think that the parts of ones job that don't hold much interest can be ignored or relegated to practice by rote – if anything these areas might need proportionately more effort investing in them to ensure ones standards are maintained across the whole of ones practice.

Most surgeons therefore would benefit from taking time to sit down periodically and plan ones CPD. This will involve reviewing ones practice, scanning the horizon for new developments in ones field(s) of practice or planned development into new areas and reviewing ones performance to identify development needs that one had perhaps not been aware of. Using this information one can therefore set out a plan for the coming period of time and ensure that provision is made both for the further development of ones special interests but also the maintenance and raising of standards across the whole of ones practice. In many healthcare systems, as in many businesses, this is formalized as part of an annual appraisal. Even if one does not work in a system that demands such appraisal, the benefits from sitting down perhaps once a year and taking stock then planning for the coming year are immense.

In making a plan various things have to be taken into consideration, not least the availability of time and funds to devote to CPD. However, it is generally true that any surgeon who is motivated by the enjoyment of their job will always find the time, whilst resources are available for any budget down to zero. For most the plan will consist of identifying the needs for the coming period of time then deciding how to address the need, with an appropriate allocation of time and resources. It is helpful in these circumstances to think about the area of practice that is to be addressed and the environments in which the CPD can take place. Examples of grids that can be used to plan a stated allocation of time can be found on the websites of any of the UK surgical colleges or surgical speciality association websites (see Fig. 1). In the UK it is a requirement that all doctors provide evidence of participation in at least 50 hours of CPD activity that is directly relevant to their practice, and covers the breadth of their practice, every year.

4. The range of developmental activities

To ensure that the CPD plan is comprehensive, therefore, one could consider ones learning needs in different areas of practice. There is a tendency just to focus on clinical matters but very few have a job that involves nothing more than running clinics and operating lists, and even these activities require more than simply knowledge about the conditions being treated. Thus a plan might consider the following areas of practice-

Clinical – What we might think of as the trauma and orthopaedics in our jobs.

Academic – Research, presentations and presentation skills, teaching, examining, writing and reviewing, for example, all require skills. All require sound governance, probity and demand the surgeon to be up to date with relevant legislation and methods.

Professional/Managerial – Many aspects of professional practice are applicable to all doctors and skills should be developed and maintained by all. Thus it is just as important to keep abreast of how to practice safely, improve quality, fulfil and develop ones role in teams and maintain trust as it is to know which hip replacement is performing best according to registry data. Furthermore surgeons who develop their careers into management roles will need to develop relevant skills, as few will have undergone any formal management training in their careers beforehand.

The plan should also consider *where* and *how* the development will take place. This should also take account of ones individual learning preferences – not everyone learns best by listening to lectures (in fact hardly anyone does) and care has to be taken to determine where the best opportunities for the individual exist.

External – This is CPD at organized events outside ones workplace and is what many traditionally think of as their CPD. It includes meetings and conferences – both speciality association meetings, subspeciality meetings and meetings convened to deal with a specific topic. Generally this sort of CPD involves time away from treating patients and financial cost but also gives the opportunity to focus without external pressures.

Internal – Education at ones own workplace can be highly relevant. This not only includes journal clubs and postgraduate meetings, but a range of other activities that can be provided by the employer or arranged among peers. Meetings to discuss difficult cases and debate treatment options are an example of the latter, whilst the former may include locally held courses such as appraiser or management courses for those developing new professional roles.

Self directed – Journal and book reading is the prime historical example of this but with the advent of the internet a wide range of options have emerged that cater for a huge range of learning styles, often available at any time that suits the surgeon.

	External	Internal	Self directed	Total
Clinical				
Academic				
Professional/Managerial				
Total				Grand Total

Fig. 1 – A grid that can be used when planning and recording annual CPD activities.

Fig. 1 on the previous page therefore illustrates a typical grid that can be used to plan and document CPD. If needed, a number of points or hours of participation can be planned and/or recorded in the grid and this can be used to document intentions at the start of a CPD cycle and to check achievement at the end.

5. Documenting continuing professional development

The grid shown in Fig. 1 is a simple method for documenting how much CPD is planned or has been undertaken. This is useful for setting out ones intentions and for checking progress or documenting achievement at different stages in the cycle. However it does not record what development has taken place. It could be argued that the record that matters is the surgeons practice. If they are fulfilling their CPD needs adequately then their practice will be safe and up to date and they will work well in their teams and get on with patients.

For many, however, what is learned at one point in time may be forgotten if not reinforced. One method that positively reinforces learning in a way that is most relevant to an individual is reflection. This may take the form of a simple note made at the end of a meeting or other learning episode stating what the surgeon learned and how they plan to incorporate it into their practice. This can refer to changing clinical practice but it might refer to the fact that the surgeon has been stimulated to look deeper into a topic, or discuss something with colleagues before making a specific change. Simply by reviewing the CPD episode in ones head and deciding what to write in a note reinforces the take home messages and makes them more likely to be acted upon. Reviewing the notes again at a later stage, or at the end of the planned cycle, adds further reinforcement.

Taken further the whole process of reflection can become a rich seam of CPD in its own right. Something learned at one meeting may stimulate further reading, further activities, debates amongst colleagues and testing of changes to practice, all of which can be formally recorded if necessary as it genuinely is contributing to the surgeons' development as a professional. Few surgeons will have time to write formal reflective essays to be reviewed and acted upon though the year, but everyone should have time to at least jot down new information, ideas and notes about skills in a place and format that is accessible for later review.

6. Summary

Continuing Professional Development is a process of lifelong learning that most will undertake because of their natural curiosity and a desire to get better at what they do. With forward planning it can be undertaken with greater efficiency and can be used to positively identify areas for improvement that the individual may otherwise not have recognized. The discipline of planning and recording also ensures that surgeons take into account the whole of their practice, not just the areas that interest them most, and this makes for safer practice. In some countries this has been formalized into part of the annual appraisal and/or revalidation process. In many more countries such processes are in the developmental phase but with time it is likely that more and more of the world's surgeons will be required to plan and record CPD. However, even if it is not mandated it still carries enormous potential benefits to the surgeon, to the purchasers of healthcare and to the patients being treated.

Conflicts of interest

The author has none to declare.

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Hi Pushpinder,
You will be pleased to know that we arrived safely back in the UK and are left with fond memories of our first trip to India. It was a privilege to have been involved with such an excellent meeting and you should be congratulated on your superb organisational skills. I believe we are hosting some of the UK Travelling Fellows and you can be assured that they will be well looked after. I look forward to being involved again in the future.
With our most warm regards,
Rob & Nicky
Mr Rob Gregory
UK

What our Delegates had to say……..

Dear Sir,
I congratulate with warm wishes. It was wonderful congress of ISKSAA 2013. It is a great platform in India for young orthopaedics surgeons to perform and establish. I was a little hesitant to reveal my feelings but I finally decided to write. Live surgeries and workshops were very useful and knowledge updating. Faculties were excellent and specific. Dr Janak Mehta was very impressive and very specific (my personal opinion). In the coming years, it will be a more bigger show. Finally, I am thankful to be selected for the fellowship in UK.
Thanks a lot Sir.
Dr Ishwar Bohra

Dear Sir,
It was a great pleasure to participate in ISKSAA 2013. I would like to personally thank and congratulate you and Dr Lalit Maini for the grand success of the event. My best wishes for the future events.
With best regards,
Dr Padmakar Shinde

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Dear Dr. Bajaj,
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"I appreciate the efforts that the organisers of ISKSAA have put in the arrangement of this fellowship. I am truly indebted to them to choose such good faculty in a center of excellence which has given me a new way of thinking in the management of my patients. I especially want to thank Dr Lalit Maini, Dr Pushpinder Bajaj for the energy they are spending in making the world a better place, I know it takes a huge effort. In the end, I would like to thank Mr Kapil Kumar, a fantastic teacher and a helpful mentor with a clear conscience that reflects in whatever he has done for us. It is a lifetime treasure which will stay with us till time immemorial."
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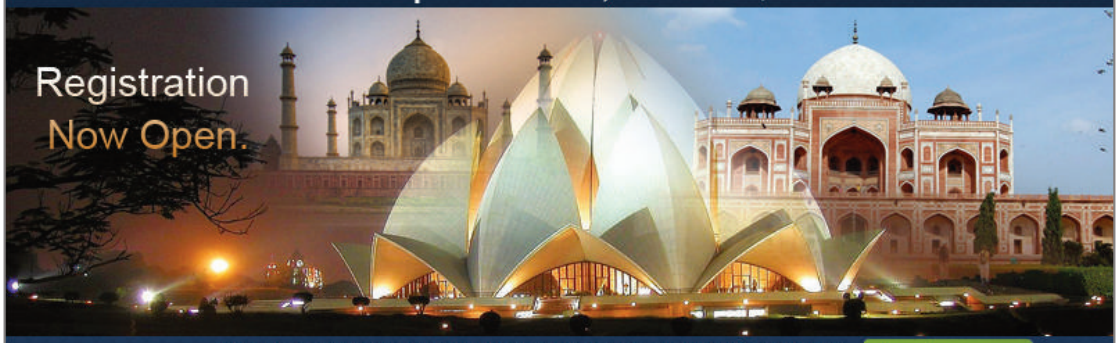

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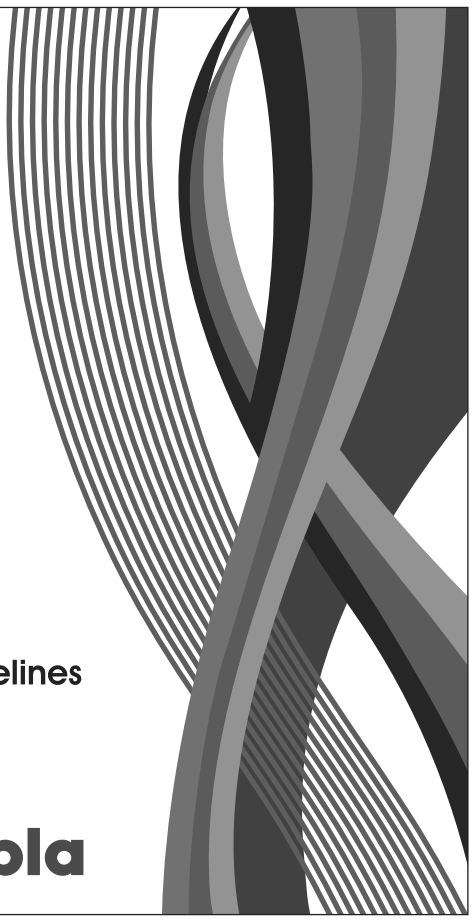

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