Elbow stiffness:

interview with Professor Bernard Morrey

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Stiff elbow is a complex condition whose diagnosis and management are sometimes quite a challenge.

Compared to the other joints, the elbow is disproportionately affected by loss of motion following trauma or surgery. It is unclear why the elbow tends to develop stiffness; its anatomical complexity, namely the presence of three highly congruent joints in the same capsule and synovial space, the tautness of the lateral and medial collateral ligaments through the whole range of motion, and the very close relationship among tendons, muscles, and skin may account for this characteristic. In a stiff elbow, it is critical to assess the possible involvement of articular and peri-articular tissues, particularly the degree of preservation of the articular surfaces and joint congruency.

Morrey et al have classified post-traumatic stiff elbow into three types:

- extrinsic contracture, which involves the soft tissue around the joint (capsule, ligaments, muscles) and heterotopic ossification across the joint
- intrinsic contracture, secondary to intra-articular fractures that have altered the anatomy of the articular surface, and
- mixed contracture, combining intrinsic and extrinsic contracture.

In the preoperative clinical assessment, we assume capsule contracture to be present in all patients with a stiff elbow. Two main associated lesions can affect prognosis and surgical management: heterotopic ossification and an altered bone joint anatomy.
According to Morrey et al.\textsuperscript{3,4}, most activities of daily living can be accomplished within an arc of motion from 30° to 130° in extension and flexion and of 50° in pronation and supination. The elbow arc of motion is not compensated for by the wrist and shoulder, thus loss of extension impairs the use of the hand in the space around the body and loss of flexion limits its use for grooming and self-care.

The elbow should carefully be tested for deformity of the axial bone alignment (varus and valgus deformity) and rotational stability.

Several treatment options are available for stiff elbow, from conservative management with a dedicated rehabilitation program to surgical treatment and from arthroscopic capsulectomy to joint replacement.

To gain a greater understanding of this complex disorder, we interviewed professor Bernard Morrey, the father of elbow surgery.\textsuperscript{5}

Professor Morrey is the pioneer of elbow surgery, known to all those working in orthopedics as “Mr. Elbow”\textsuperscript{1,5} for his outstanding contribution to the study and treatment of a formerly neglected joint. In particular, his book The Elbow and Its Disorders, first published in 1985\textsuperscript{6}, now nearly in its 6\textsuperscript{th} edition, and the Instructional Course Lectures, published in 1985, are milestones in the field.\textsuperscript{5,7}

Professor Morrey, a native of Texas, grew up in Fort Worth. A mathematician by training, he worked for a time as an aerospace engineer with NASA, in Houston, on
the Apollo missions. He attended medical school at the University of Texas Medical Branch. He completed an internship and residency at Mayo Clinic Rochester, during which time he also received a master’s degree in biomechanics from the University of Minnesota. After two years of service in the Air Force, he joined the staff at Mayo in 1978. He assisted Dr. Ralph Coonrad in the design of the Coonrad-Morrey total elbow replacement, which since the 1980s has been the most commonly used elbow prosthesis worldwide. Professor Morrey is a founding member and past president of the American Shoulder and Elbow Surgeons and past president of the American Academy of Orthopedic Surgeons and of the American Orthopedic Association. He has long held the chair of orthopedics at the Mayo Clinic. He has been chair of Trustees of the Journal of Bone and Joint Surgery and of the Journal of Shoulder and Elbow Surgeons as well as a member of numerous specialty orthopedic organizations. He was the surgeon to Senior President and Mrs. Bush. He holds nine patents and is the author of 15 major textbooks under four different titles, which have been translated into six languages, and of over 440 peer-reviewed publications. He holds the academic rank of Professor of Orthopedics at both the Mayo Clinic and at the University of Texas Health Science Center, San Antonio. His wife, Carla, and their four children all work in the medical profession.
Interview

1. Which parameters do you assess to classify elbow stiffness?

While one can classify stiffness from several perspectives, I continue to first consider whether there is joint involvement. The ultimate determinant of successful intervention is the quality of the joint. If it is severely compromised this must be addressed or the release will not be effective. Other considerations do enter into the decision making such as the extent of the soft tissue damaged including static and dynamic elements. Finally the duration of the contracture is important as the soft tissues contract around the arc of motion that is present.

2. Do you feel that the classic evaluation of functional range of motion in terms of degrees is still appropriate to rate joint movement?

The beauty of our specialty is we continue to improve, refine and hopefully improve our treatments and outcomes. I continue to feel there is great merit in defining foundations and principles of when and how to intervene. The traditionally accepted ‘functional arc’ of 30 -130 is not absolute, but a frame of reference. However, there is a more important consideration that always is the most important and that’s simply “how much motion do you need, for whatever you have to do”? Some of my most grateful patients have very limited arcs of motion, but can now get their hand to their mouth, or to their peroneum. Again, it all goes back to what’s needed.
3. **What imaging studies do you recommend to assess joint stiffness and plan treatment?**

Ninety percent of the time I am good with plane AP and lateral films. If heterotopic ossification (HO) is present then I add a CT scan and feel that, in complex HO distribution, a 3D reconstruction is very useful.

Of interest I am a big fan of T99 scans for many diagnostic challenges, but it is useless when determining when to intervene in the presence of HO.

4. **In your experience, which patients should not be treated for elbow stiffness?**

The simple answer is only when the risk benefit ratio is unfavorable. As hard to believe as it may be, the day I am responding to these question is the very day I told a patient with a post traumatic spontaneously fused elbow that I could not offer him a procedure. I explained in detail the chance of success was very limited, and the likelihood of gaining motion was far outweighed by the potential for a painful arc, or a major complication such as neurovascular injury. One extremely important patient variable is whether the individual is realistic regarding the risks and likelihood of a desired benefit. If the patient is not accepting of this reality, this becomes a near absolute contraindication.

5. **Which parameters do you apply to establish whether a stiff elbow requires rehabilitation or surgery?**
Experience has taught us that some conditions do not respond to therapy, except adversely. I often work personally with the patient if they are local but must rely on therapy if they are from a distance. Those with a bad joint will not respond to therapy and we then offer surgery. We also pay special attention to the temporal response pattern. If no improvement in 2-3 weeks, reconsider. I do use passive and dynamic splints instead of therapy in many of my patients. The one aspect of recovery of which I think PT is beneficial is to address reflex inhibition. I don’t feel PT is reliably successful, but is far better than any other option of which I am aware.

6. **When should rehabilitation be converted to surgery?**

Assuming we are using PT, or splints, there are two considerations: when progress, if any, has stopped, and the final outcome is not acceptable.

7. **What are your chief considerations when you opt for surgical management, whether open or arthroscopic?**

The principles described above still obtain: what arc of motion does the patient need; what does the pathology suggest is possible; has sufficient time and effort been applied to know a procedure will be necessary and if so, what procedure will be needed; am I capable of performing the procedure; will successful execution result in a positive risk/benefit proposition?
8. Is the indication to remove heterotopic ossifications based exclusively on their maturity or should other aspects, such as site or extension, also be considered?

The timing of the excision is based on maturity. Maturity, for me is based on plane radiographs demonstrating a sharply demarcated margin of the process. I also consider the calendar and rarely excise before 6 months. My experience has also indicated that HO that is in the muscle is ‘untidy’ and more difficult to remove, and more likely to recur. This is especially true when the excision has been performed when the process is still active. For me HO is a most worrisome feature of post traumatic stiffness because the process often occurs anteriorly and can involve the neurovascular structures. If intervention is considered in this setting, I will typically order vascular imaging. Such pathologic features, if present, of course markedly increase the risk component of the equation.

9. Should the muscle-tendon retraction (triceps, brachialis, biceps....) involved in elbow stiffness be managed by rehabilitation or by surgery?

In almost all instances, these problems are best managed non-operatively. I ask myself, “if I try to limit motion by a myodesis procedure, will it be successful, or stretch out?” Of course, it will fail with time. The exception is if the injury or insult has altered the compliance or integrity of the myotendinous unit. If the structure has been injured and can no longer physically stretch to the desired length, then surgical lengthening may be indicted. But a note of caution, If the procedure has restored
functional motion, then I usually do not further surgically address myotendinous contracture.

10. Based on your experience, does the retraction of ligament structures play a major role in elbow stiffness?

When do you recommend treatment? The presence of contracted ligaments is a real entity and may be complicated by intrasubstance calcification. A detailed understanding of the anatomy and biomechanics is necessary to address ligamentous involvement in a contracture. Laterally, the ligament complex arises from the tubercle at the projected center of the capitellum. The humeral attachment is essentially isometric throughout the flexion arc. Hence laterally the ligament complex is a factor only if the length and mechanics are distorted by calcification in the substance of the ligament. Medially the anterior bundle is near isometric through the arc of flexion, but the posterior bundle is not. This then, if contracted, can limit flexion and is routinely released in order to further improve flexion. In reality, after the anterior and posterior capsules are addressed, we then flex and extend the joint. With flexion pressure hear and feel something give, and inspection reveals this to have been due to rupture of the posterior bundle of the medial ulnar collateral ligament. Improved motion when extending the elbow is usually due more to rupture of residual capsule than ligamentous tear.
11. In your opinion, does ulnar neuropathy (whether pre- or post-operative) affect the indication for rehabilitation or surgical treatment?

I consider the ulnar nerve to be the ‘sleeper’ when addressing elbow contracture. We first became aware of the marked impact of ulnar nerve involvement as a result of Dr. Samuel Antuna’s, U of Madrid, assessment of our open contracture releases. We found the amount of improvement to be directly correlated to the involvement of the ulnar nerve. As a result we carefully assess for symptoms or signs of ulnar nerve involvement and if any symptoms at all, we do an in situ decompression. Further, if the pre-treatment flexion is less than 90 degrees, we decompress the nerve as we are concerned gaining additional flexion will compromise the nerve. Again, if a patient has ulnar nerve pain or irritation, the amount of motion gained is lessened. Finally, the patient may in fact be unaware of the medial symptoms, so the cause effect may be a silent process.

12. Based on your experience, which patients with a stiff elbow benefit from interposition arthroplasty, total elbow arthroplasty or hemi humeral arthroplasty?

The simple answer is those with an intrinsic contracture, ie joint damage. This is most often due to trauma, but can also occur with inflammatory processes. I have employed all three treatment modalities. In the younger patient I prefer interposition arthroplasty, including young patients with systemic inflammatory disease. Trauma that destroys the distal humerus, ie shear fractures, are good candidates for hemi
replacement, if available. I have reserved elbow replacement for the older patient, with fused or very limited motion, ie < 30 degrees. In general, today I offer interposition as the first choice in those <65 years.

14. What are the surgical tips that in your opinion ensure a successful TEA?

The key points that improve survival of the implant and provide the best function are:

- Exposure that preserves the tendinous attachment of the triceps.
- Identify the ulnar nerve. If it is in the groove, translocate it into a subcutaneous pocket. If already moved, dissect enough to protect it from harm.
- Releases contracted soft tissue medially and laterally to avoid residual angular deformity and anterior and posterior tissue to improve the flexion/extension arc.
- Awareness of the humeral and ulnar morphology, specifically angular dimensions and size of the canals, especially that of the ulna.
- Avoid time spent ‘working the bone’ to get in a bigger implant. Avoid excessive operating time and tourniquet time.
- Use cement restrictors, especially in the humerus.
- Add antibiotics to the cement
- Use an injector system to deliver the cement
- Assure proper component placement using the flexion axis as the primary landmark.
- Avoid inserting either component beyond the axis as this can create a soft tissue fulcrum that can loosen the ulnar component.

- Analgesic cocktail to lessen post operative pain medications.

- Careful hemostasis and I do not drain the elbow.

- Anterior splint and elevation to the recovery room

15. Would you like to share with us the key points you consider in the diagnosis and treatment of joint stiffness?

As already mentioned, but to emphasize: spend time with patient to understand what they want/need.

Assess the pathology to determine if amenable to treatment and to attain the goals of the patient. If these can’t be attained, intervention may still be offered, but the expectations adjusted. Realistic explanation to the patient of the potential risks, their implications and an estimate of their frequency.

Consideration of impact and salvage option of failure.

An honest assessment one’s ability to do what must be done, and referral to a more experienced surgeon if this is in the patient’s best interest.
The ISAKOS Elbow and Wrist Committee wish to express their deep appreciation for professor Morrey’s outstanding work and key role in providing a clearer understanding of this complex joint. We are also grateful for his participation in the present ISAKOS project and for sharing his knowledge with us.

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