

The role of arthroplasty in the rheumatoid shoulder

O papel da artroplastia no ombro reumatoide

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Abstract

Rheumatoid arthritis is the most common inflammatory joint disease. It is characterized by a proliferative synovitis that symmetrically affects several joints and, if not promptly diagnosed and treated, leads to severe joint destruction. Shoulder involvement by rheumatoid arthritis is very common, affecting more than half of the patients and almost all patients with long-standing disease have their shoulder joints severely damaged. As a result of joint destruction patients present significant shoulder pain, upper limb impairment and, consequently, a decreased quality of life. Shoulder arthroplasty has shown to be a reliable treatment for patient with rheumatoid arthritis of the shoulder refractory to conventional therapy. Both significant pain relief and functional improvement have been delivered by this treatment modality and, therefore, patient's quality of life is ameliorated. A careful preoperative assessment and an early referral to an orthopedic surgeon are paramount in order to properly plan joint replacement and avoid complications.

Keywords: Shoulder; Arthroplasty; arthritis, Rheumatoid.

Introduction

Rheumatoid arthritis (RA) is the most common inflammatory joint disease, affecting 0.5-1% of the world's population ^{1, 2}. It is a chronic, systemic autoimmune disease characterized by symmetrical inflammatory polyarthritis that results in progressive joint destruction, deformity and disability ^{2,3}.

Due to the polyarticular nature of RA, shoulder involvement is frequent, although generally occurring late in the disease process ⁴. It is estimated that 65-90% of RA patients complain of shoulder pain ⁵ and that 80-90% of patients with more than 15 years of disease duration have their shoulder joints severely affected ⁶. As a result, patients have significant upper limb function impairment with a consequent decrease in their quality of life. Early detection and treatment of rheumatoid arthritis of the shoulder is therefore crucial.

The intention of the following paper is to review the role of arthroplasty as a therapeutic strategy in the treatment of the rheumatoid shoulder and to emphasize the importance of early referral to an orthopedic surgeon.

Search Strategy and Criteria

A comprehensive search of the US National Library of Medicine (PubMed) using the terms “shoulder”, “arthroplasty”, and “rheumatoid arthritis” was performed. Studies that involved at least 5 rheumatoid arthritis patients treated with shoulder arthroplasty, written in English or Portuguese, and published between the years 2000 and 2012 were included. Articles that solely presented mixed results in terms of etiology or did not include primary arthroplasties were excluded, as so were reports to which we had no access to full text.

Clinical Patterns

RA of the shoulder is characterized by a proliferative synovitis (pannus) that affects bone, cartilage and the periarticular soft tissues leading to bone loss, thinning of cartilage, muscle atrophy, fatty infiltration, tendinitis and bursitis. Patients may present with pain, swelling, loss of strength, stiffness and/or motion restriction ⁷.

The disease mainly affects the glenohumeral joint although involvement of the subacromial bursa and acromioclavicular joint may be present in an early stage. The sternoclavicular joint may be affected but rarely requires specific treatment. Failure of the rotator cuff usually occurs late in the disease process. Joint destruction most commonly follows the typical symmetrical pattern of RA ⁸.

Imaging

Considering the severity of morbidity caused by shoulder RA, early detection of inflammation is crucial for the prevention of irreversible damage. Imaging studies are essential for diagnosis and to guide treatment. They should be performed based on symptoms.

Conventional radiography is capable of detecting bone erosions, joint space narrowing, juxta-articular osteoporosis, cysts and subluxations but is unable to detect early disease manifestations such as inflammatory changes in soft tissues and the earliest stages of bone erosion ^{9, 10}.

Magnetic resonance imaging (MRI) and musculoskeletal ultrasound (US) are more sensitive than radiography in demonstrating synovial, cartilage and bone lesions ^{9, 10}. US can visualize effusion, bursitis and tendon integrity ^{7, 11, 12}. MRI can be used to accurately evaluate synovitis, bone and cartilage damage, soft tissue and the rotator cuff ^{7, 9, 10, 13}. MRI provides good images of the glenoid fossa, information on muscle and

bone stock ⁷, and is the only exam capable of showing bone marrow edema ^{9, 10}. Hence, MRI is now the reference standard to assess the rheumatoid shoulder and a crucial exam for surgical planning ⁷.

Computed tomography (CT) was considered a reference standard in the assessment of bone erosions, it however visualizes soft tissue inadequately in comparison to MRI, and thus has been superseded by the latter. CT is useful when a precise assessment of bone destruction and stability is needed, such as preoperative evaluation ^{7, 9}.

Treatment

Management of shoulder RA should always start with appropriate pharmacological agents (analgesics, non-steroidal anti-inflammatory drugs, glucocorticoids and/or synthetic or biological disease--modifying antirheumatic drugs) ⁷. Treatment should start as soon as RA is diagnosed or suspected. It has been shown that early and aggressive treatment is effective in minimizing inflammation, pain, stiffness and in preventing radiographic progression ¹⁴⁻¹⁶. Local glucocorticoid injections are the first-line local treatment in patients with shoulder symptoms but without joint space loss ⁷. If these measures fail, radiosynovectomy may be an effective option if performed early ^{7, 17}. When conservative management does not result in sufficient improvement, surgical procedures are the remaining treatment option. In the early stages of joint destruction surgical synovectomy is effective in pain reduction and joint function improvement ^{7, 18}. Arthroplasty should be considered when joint space loss is noted on radiographs or when pain and functional impairment cannot be controlled by other treatment modalities ^{7, 19}.

The surgical option

Surgical treatment of the rheumatoid shoulder has a dual role by preventing disease progression and treating pain and dysfunction. Decisions to perform surgery should always be based on imaging findings, degree of pain and disability and the patient's wishes.

Surgical synovectomy and debridement is recommended when patients do not experience pain alleviation with 6 months of conventional therapy. Both the open and arthroscopic approaches are valid, although arthroscopic synovectomy is less invasive. Removal of the inflamed synovial lining decreases pain and swelling and slows disease progression. In addition mechanical irritants such as unstable cartilage flaps and loose bodies are removed by this modality^{18,20}.

Shoulder arthroplasty is indicated when all the other treatment options fail to control symptoms or as soon as joint space loss is noted on radiographs⁷. Shoulder joint replacement relieves pain and improves function, and consequently ameliorates quality of life²¹.

Preoperative considerations

When planning joint replacement surgery the following aspects should be taken into account:

- RA is a polyarticular disease, affecting several joints simultaneously. It is essential to always consider the state of other joints in the surgical plan. Function of the limb may continue to be impaired after surgery if other joints of the same limb are affected^{22, 23} thus there is usually an indication for arthroplasty of multiple ipsilateral joints. Whether to first replace the shoulder or the elbow is an unsolved problem²². A one-stage surgery may be an option

when both ipsilateral elbow and shoulder arthroplasty is needed. Good results, matching those of a 2-stage surgery have been obtained, with the advantage of a single hospital stay and the use of less anesthetics^{22, 23}. Additionally, patients undergoing lower limb surgery require the use of crutches postoperatively which increases shoulder load, therefore lower limb surgery should be performed before shoulder surgery²⁴.

- Age is an important factor in decision-making. Although shoulder arthroplasty is usually reserved for older patients, young patients may have their shoulder joints sufficiently affected requiring arthroplasty. The increased physical demands of younger patients, the need for prosthesis with a longer life span and the possibility of a future revision surgery are all aspects that influence the decision process²⁵.
- Bone quality in RA is poor due both to the underlying disease as well as to therapy with glucocorticoids²⁶. It is important not to delay surgery as inadequate bone stock limits surgical treatment and is associated to several complications²⁷⁻²⁹. Furthermore, it is essential to correctly evaluate bone status preoperatively in order to properly select prosthesis.
- RA patients have an increased risk of infection compared to general population in part from the disease itself and in part from the immunosuppressive therapy^{30, 31}. Risks and benefits of continuing or stopping medications during the perioperative time should be carefully balanced for both uncontrolled disease and treatment increase infection rate.
- RA of the shoulder joint causes thinning and fatty degeneration of the rotator cuff. Sperling et al evaluated the condition of the rotator cuff intraoperatively, and found that 45% of shoulders had thinning of the rotator cuff and 24% had a

full-thickness tear³². Similar results were found by Trail and Nuttall. In their study, 35% of shoulders had a thin and atrophic rotator cuff, 47% had a tear, of which 24% were full-thickness³³. It is important to assess the integrity of the rotator cuff before surgery for cuff tears and fatty infiltration are associated to worse outcomes^{32, 34, 35} and appropriate techniques are available for these cases.

Total shoulder arthroplasty

Total shoulder arthroplasty (TSA) consists in the replacement of glenoid and the humeral head and is indicated in RA patients with an intact or reparable rotator cuff and adequate bone stock (figure 1)^{27, 36, 37}.

TSA has shown to provide satisfactory long-term pain relief and improvement in range of motion (ROM) and arm function^{32, 33, 38, 39}. Sperling et al., in a retrospective study that included 195 TSA in rheumatoid patients, found that TSA significantly reduces pain and improves range of motion and is well tolerated with a survival rate of 89% at 20 years. Additionally, they showed that reductions in pain and gains in abduction were greater in patients with an intact rotator cuff and that these patients have a lower risk of revision (compared to those with a torn or thin rotator cuff)³². These findings are in accordance with previous results reported by Trail and Nuttall. They observed satisfactory pain relief as well as improvement in movement and strength, and good mid-term survival rates. An association of better results with an intact rotator cuff was also reported by these authors³³. Likewise, in an analysis of prognostic factors in arthroplasty of the rheumatoid shoulder a positive correlation was found between clinical outcome and the state of the rotator cuff³⁷. Good survivorship for TSA in the

long-term was also reported by Deshmukh et al. In their analysis TSA had a failure rate of 5.9 % in RA patients ⁴⁰.

Clement et al. evaluated the outcomes of TSA in 48 rheumatoid shoulders. Constant Scores were significantly improved and survival rates were 91.7% at 5 years and 89% at 10 years. This study differs from the rest for it uses a metal-backed glenoid component, opposed to the all-polyethylene glenoids used in the other reports ⁴¹.

Hemiarthroplasty

Hemiarthroplasty (HA), consisting in a stemmed prosthesis placed on the humeral side, is indicated in patients with a massive cuff tear that has allowed superior migration or with insufficient bone stock for glenoid component fixation. An intact cartilaginous glenoid surface is required when performing HA ^{42, 43}.

HA provides satisfactory long-term pain relief and gain in ROM ^{32, 33, 38, 44}.

Sperling et al. analyzed 109 rheumatoid patients with HA. They found significant pain reduction and improvement in ROM and a survivorship of 89% at 20 years ³². A similar 20 years survival rate has been previously reported by these authors ³⁸.

A more recent study on risk factors for revision surgery has reproduced the survival rates reported by Sperling et al. A 91.8% survivorship at 20 years was found for HA in RA patients. Higher revision rates were found to be associated to younger age and higher body mass index ⁴⁵.

Good outcomes in pain reduction and ROM improvement for HA were also reported by Gadea et al. A survival rate of 100% at ≥ 8 years was documented by these authors ⁴⁴.

Total shoulder arthroplasty vs Hemiartroplasty

Different results have been obtained when comparing HA to TSA. Some studies have shown no difference in terms of pain relief and function improvement ^{32-34, 46} and survival rates were found to be similar for both groups ³². The same results were seen when comparing HA and TSA in young patients ²⁵. Contrarily, Pfahler et al. found better outcomes with TSA in comparison to HA in the rheumatoid patient ⁴⁷. A systematic review showed the same results ³⁹.

Whether to choose TSA or HA when there is an intact rotator cuff and adequate bone stock remains controversial. Both prosthesis have similar survival rates and deliver good outcomes in respect to pain and function. HA has been the preferred treatment for younger patients, although there seems to be no difference in outcomes when using either prosthesis. The risk of component loosening in the long-term and the alterations of bone stock complicating further surgery caused by TSA are the main reasons for this choice. Other reasons favoring HA over TSA may include the simpler and quicker technique in HA and lower costs ²⁷.

Surface replacement arthroplasty

Surface replacement arthroplasty involves the replacement of the damaged joint-bearing surfaces. With this technique anatomy is restored with minimal bone resection ⁴⁸.

Resurfacing of the humeral head has similar indications to those of stemmed arthroplasty ⁴⁹ and is suitable for patients with elbow prosthesis ^{49, 50}. Resurfacing should be avoided in patients with > 40% of humeral head loss or when the humeral bone is too soft to provide fixation ⁴⁹.

Good outcomes in terms of pain and function have been delivered to rheumatoid patients with shoulder surface replacement arthroplasty ⁴⁹⁻⁵²

Levy et al. reported on 75 surface replacement arthroplasties for the treatment of rheumatoid shoulder with a mean follow-up of 6.5 years. Pain relief and improvement in ROM was achieved with surface replacement arthroplasty and was comparable to that obtained by conventional TSA. Revision surgery was needed in only 3 patients, two of which underwent arthroplasty as a “limited goal” procedure ⁴⁹. Their results are consistent with outcomes in a previous mid-term report by Levy and Copeland in 2001 where 41 rheumatoid shoulders underwent resurfacing arthroplasty. Reduction in pain and improvements in ROM were observed: 97.5 % of patients considered their shoulder to be better or much better after surgery. Only one patient, that also underwent arthroplasty as a “limited goal procedure”, required revision surgery ⁵¹. A more recent study by the same authors with a mean follow-up of 8.6 years and involving 103 shoulders replicated these outcomes ⁴⁸. In a report of 45 rheumatoid shoulders with surface replacement of the humeral head, all patients had substantial pain relief and improvement in function and therefore improvements in activities of daily living. No differences in outcome were observed in patients when analyzing the rotator cuff status. No complications were noted in this study ⁵⁰. Similar outcomes in terms of pain and function were obtained by Thomas et al. in 2005. No revision surgery was required in the 5-year survival analysis ⁵².

Reverse total arthroplasty

Reverse total shoulder arthroplasty (RSA) consists in a convex articular surface that is fixed to the glenoid and a humeral stem with a concave proximal end. It is indicated in patients with massive irreparable cuff tears or as a revision arthroplasty for failed HA or TSA (figure 2) ⁵³.

RSA has delivered good pain relief and improvements in upper-limb function to RA patients⁵⁴⁻⁵⁷.

A prospective study with a minimum follow-up of 2 years (average 36 months) involving 21 rheumatoid shoulders, all with rotator cuff deficiency, demonstrated significant improvement in pain, function and ROM. Clinical outcomes measures were not related to Larsen grade, atrophy of any of the rotator cuff muscles, degree of preoperative glenohumeral instability or degree of glenoid erosion. When questioned about their satisfaction, 85% of patients rated the outcomes as good or excellent. Three patients required reoperation, two due to infection and one to a fracture after a fall⁵⁴.

Rittmeister and Kerchbaumer reported on eight shoulders that underwent reverse total arthroplasty for RA and an irreparable rotator cuff. The study had a mean follow-up of 53.4 months. All patients were satisfied with the outcome of surgery. They all had significant pain relief and functional improvement. Slight improvements in arm strength, mostly of arm flexion were observed. In this study 3 patients required revision surgery, all due to failure of acromial osteosynthesis and 2 of them required further surgery due to loosening⁵⁶.

A recent short-term study prospectively analyzed outcomes of reverse total arthroplasty on 17 severely destructed rheumatoid shoulders with an irreparable rotator cuff tear. Function was found to improve after surgery achieving 80.7% of normal population's for the Constant score. Although there were functional limitations, patients had marked pain relief, improvement in activities of daily living and reduction in the negative psychosocial effects of RA resulting in increased quality of life. A high degree of patient satisfaction was documented during the 2 year follow-up. None of the implants required revision surgery⁵⁵. These findings replicate those of an earlier retrospective analysis⁵⁷. In a recent study with a mean follow-up of 3.8 years and that involved 18

primary RSA, Constant scores and function were significantly improved. All patients, except for one, were satisfied or very satisfied with the results and no revision surgeries were required ⁵⁸.

Complications

As in all surgeries, shoulder arthroplasty is not free from complications. Component loosening, defined as implant migration or a periprosthetic radiolucent line of 2mm, is a common complication of shoulder arthroplasty, although only a few shoulders require revision. Aseptic loosening mostly occurs on the glenoid side and has been associated to poor bone stock, rotator cuff insufficiency, poor cementing technique and osteolysis due to polyethylene wear. ^{28, 59-62}.

Glenoid erosion due to contact between the metal humeral head and the glenoid cavity is a frequent complication and exclusive to hemiarthroplasty. As a result, patients present pain that may be sufficient for them to require revision surgery ⁵⁹.

Notching of the scapular neck is a complication unique to RSA and results from repetitive impact of the humeral component against the scapula. It has shown to be the most common complication of RSA and is concerning, for bone loss could potentially lead to glenoid loosening, although its clinical significance remains controversial ^{53, 63}.

Complications common to all prosthesis include instability, infection, periprosthetic fractures, neural injuries, soft-tissue lesions and hematomas. Postoperative instability is one of the most frequently reported complications and has been associated to various factors, namely, malpositioning, inadequate glenosphere diameter, deltoid dysfunction, poor subscapularis muscle, impingement and glenoid wear ^{28, 53, 61, 63}.

Deep infection most frequently develops secondary to patients' immunosuppressive state and, although uncommon, is a devastating complication of shoulder joint replacement^{28, 64}.

Fractures may occur intra-operatively or postoperatively, and can involve both the humerus and the glenoid. Intraoperative fractures are mostly due to osteopenia and technical errors^{28, 29, 63}. Acromial fracture may occur in RSA but usually only require symptomatic treatment^{29, 63}.

Injuries to the brachial plexus, axillary and radial nerves are relatively common complications of shoulder arthroplasty but are usually spontaneously reversible, and result from surgical technique, patient positioning and excessive tension^{28, 64}.

Tears of the rotator cuff and rupture of the subscapularis tendon are relatively frequent and may compromise shoulder arthroplasty by placing the shoulder at risk of instability. Deltoid muscle dysfunction secondary to axillary nerve injury or iatrogenic detachment can severely compromise outcomes but is a rare complication when the extended deltopectoral approach is used^{28, 64}.

Postoperative hematomas may occur and be large enough to require reoperation for evacuation or drainage but are preventable by the use of drains, proper hemostasis and by delaying motion of the shoulder⁶⁴.

Minimizing complications and future considerations

With advances in prosthetic designs and refinements in surgical techniques shoulder arthroplasty has become a safe procedure, especially when there's an appropriate patient assessment and proper surgical timing.

Glenoid component loosening is the most important concern of shoulder arthroplasty. Efforts have been made to improve glenoid fixation and, therefore, prevent loosening. In order to optimize congruency between the implant and the bone, reaming of the glenoid subchondral bone is advised^{28, 61, 65}. In patients with glenoid bone deficiency bone grafting can be used to improve component fixation^{61, 65, 66}. Cemented all-polyethylene components are the current gold standard in TSA. Of the two available designs, keeled and pegged, the latter have shown to provide better postoperative results in terms of lucency^{67, 68}. Cementing techniques have evolved over the years. The current recommendation is to inject the cement with a syringe and mechanically pressurize it. It is important to minimize subchondral bone removal, clean all blood and soft-tissue debris and meticulously dry the glenoid before cement insertion. Overstuffing should be avoided⁶⁹. Cementless designs for total shoulder replacement, that theoretically offer many advantages over cemented prosthesis, have been developed but results have been discouraging^{28, 70}. In the future, cementless implants designs using technology that encourage bone ingrowth may be an option⁶⁸. Polyethylene wear has been identified as a major factor of glenoid loosening. Alternative bearing surfaces to the conventional metal-on-polyethylene bearing may be a solution to this problem. Metal-on-metal, ceramic-on-ceramic and ceramic-on-polyethylene bearings have been tested in vitro and used in lower limb arthroplasty and all have shown favorable wearing characteristics compared to metal-on-polyethylene bearing. However, their use has been limited due to real and potential difficulties⁷¹. Increasing material's resistance to wear may be another possible approach to minimizing glenoid loosening. Cross-linking of polyethylene molecules by reducing the mobility between adjacent polyethylene chains increases the material's resistance to deformation and wear. Highly cross-linked

polyethylene bearings have been used in lower limb arthroplasty with promising results⁷¹.

Biologic resurfacing of the glenoid with soft-tissues like joint capsule, fascia lata, meniscal allograft and Achilles tendon allograft has been described to reduce glenoid wear and may be used in hemiarthroplasty to prevent glenoid erosion, particularly in the young patient^{27, 28, 67}.

Notching of the scapula can be minimized by placing the glenosphere in a distal position and by lateralizing the center of rotation^{53, 63}.

In patients with ipsilateral shoulder and elbow implants short stemmed prosthesis may be used to overcome the difficulties posed by long stems³⁵.

Arthroplasty is most commonly performed by a deltopectoral approach which requires an incision of about 17 cm and the release of the subscapularis tendon. A new and less invasive approach, only requiring a 5 cm incision lateral to coracoid process and minimal periarticular soft-tissue disruption, is being developed. Advantages of this minimally invasive approach include reduced morbidity, faster recovery and improved outcome and cosmesis^{72, 73}.

In addition to advances in the surgical field with the use of improved prosthetic designs and new materials and approaches, it is important to also improve the pharmacological treatment of shoulder RA in order to slow down disease progression, improve general health and decrease local destruction.

Conclusion

Shoulder arthroplasty is a reliable treatment option for patients with rheumatoid arthritis of the shoulder refractory to conventional treatment. The procedure significantly

reduces pain and improves function, and therefore ameliorates patient's quality of life. Best results are achieved when patients are carefully assessed and when extensive bone loss is prevented by early referral to orthopaedic surgery.

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Subtitles

Figure 1

A – Anteriorposterior radiograph of the right shoulder of a patient who underwent total shoulder arthroplasty.

B- Axillary view of the same patient.

Figure 2

A – Anteriorposterior radiograph of the right shoulder of a patient who underwent reverse total arthroplasty.

B- Axillary view of the same patient.

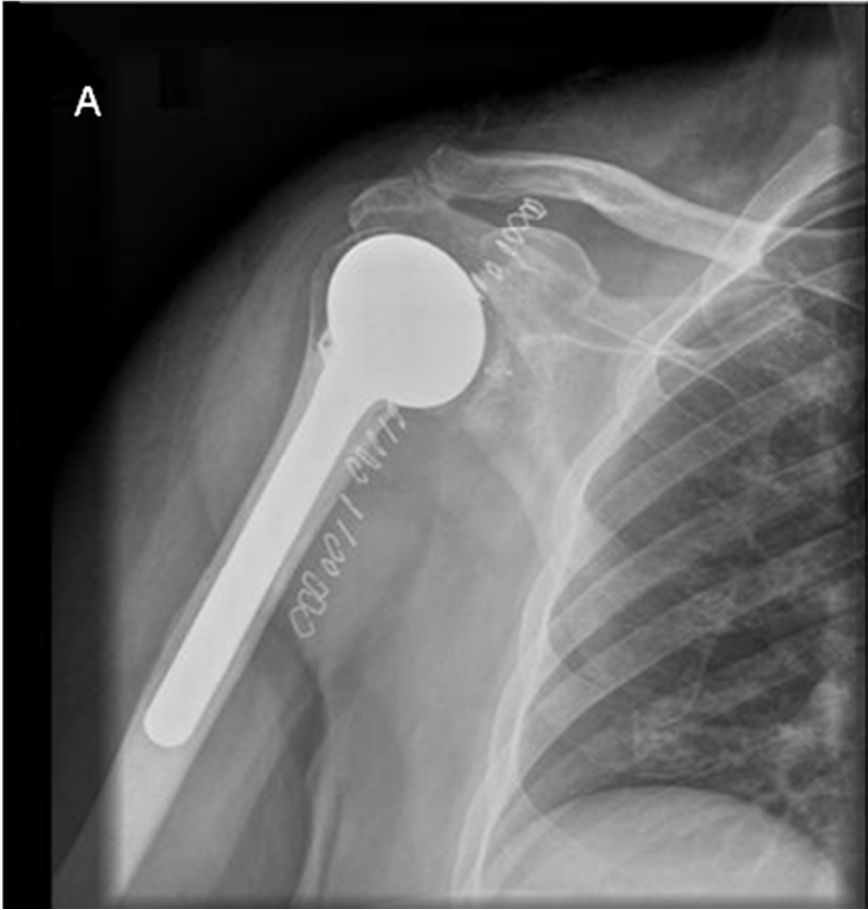


Figure 1 A



Figure 1 B



Figure 2 A



Figure 2 B

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To all those who have believed in me, thank you from the bottom of my heart!

“We are the masters of our fate”

Winston Churchill

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