VuMedi Webinar 20.05.2013

Chronic tear of the Tendo Achillis
Minimally Invasive Achilles Repair with Soft Tissue Augmentation

Nicola Maffulli MD, MS, PhD, FRCS(Orth)

DISCLOSURE

- **None relevant to this presentation**

Chronic rupture of the Achilles tendon

Epidemiology

- **The Achilles tendon (AT) is the most commonly rupture tendon in the human body.**
- **Complete ruptures of the AT: sedentary and athletes patients**
- **Common in middle aged men who occasionally participate in sport.**

Maffulli N. Rupture of the Achilles tendon. J Bone Joint Surg Am 1999; 81(7):1019-36

Longo UG, Ronga M, Maffulli N. Acute ruptures of the achilles tendon. Sports Med Arthrosc 2099;17(2):127-38

Maffulli N. The clinical diagnosis of subcutaneous tear of the Achilles tendon. A prospective study in 174 patients. Am J Sports Med 1998; 26(2):266-70

Chronic rupture of the Achilles tendon

Definition

- **Variable**
- **Timeframe is to 4 to 6 weeks from the time of injury.**
- **When there has been a delay in treatment, ruptures may be called chronic, neglected, or old.**

Boyden EM, Kitaoka HB, Cahalan TD, An KN. Late versus early repair of Achilles tendon rupture. Clinical and biomedical evaluation. Clin Orthop Relat Res 1995; (317):150-8.

Gabel S, Manoli A, 2nd. Neglected rupture of the Achilles tendon. Foot Ankle Int 1994; 15(9):512-7.

Mann RA, Holmes GB, Jr., Seale KS, Collins DN. Chronic rupture of the Achilles tendon: a new technique of repair. J Bone Joint Surg Am 1991; 73(2):214-9.

Zadek I. Repair of old rupture of the tendo-Achilles by means of fascia. Report of a case. J Bone Joint Surg 1940; 22(4):1070-1071.

Chronic rupture of the Achilles tendon

CASE 1

Chronic rupture of the Achilles tendon

- **32 year old gentleman**
- **Not known allergies**
- **Not relevant medical history**
- **No quinolones**
- **No corticosteroids**
- **No prodromal symptoms**
- **Sports (running and soccer) twice/week**
- **July 2012: “I felt a hit in the calf of the left leg while running”**

Chronic rupture of the Achilles tendon

Case

- **Attends A&E**
- **Can walk, can plantar flex against gravity**
- **'Sprained ankle'**
- **Given a walker, told to rest**
- **Discharged**

October 2012

- **6 weeks of immobilization**
- **6 weeks of physiotherapy**
- **After 4 months, patient walks flat footed, non-propulsive gait, swollen ankle**
- **Can feel a three finger gap at the back of the ankle**
- **Reassured!!!**

What to do next?

October 2012

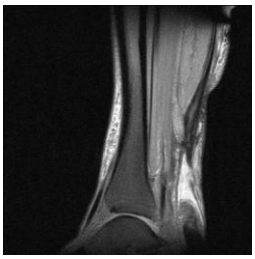
- **Physical examination:**
- **Calf squeeze test: no movement**
- **Knee flexion test: fall of affected foot**

All the above documented in notes

Reassured

November 2012

- Goes to a pub, sees a friend (a rugby playing lawyer), who makes the diagnosis
- Referred to CSEM
- Diagnosis: chronic Achilles tendon rupture
- Gap: 6 cm clinically



- US study: scar tissue formation in the mid body of the Achilles tendon
- MRI: 6 cm of scar tissue formation

Chronic rupture of the Achilles tendon

Operative management

- V-Y Tendinous flap
- Fascial turn down flaps
- Peroneus brevis transfer
- Flexor digitorum longus
- Flexor hallucis longus
- Fascia Lata
- Gracilis
- Semitendinosus
- Allografts

Chronic rupture of the Achilles tendon

Classification

Myerson's classification system

1. Defects 1-2 cm→ end to end repair and posterior compartment fasciotomy
2. Defects 2-5 cm→ V-Y lengthening +/- tendon trasnfer
3. Defects > 5 cm→ tendon transfer +/- V-Y advancement

Kuwada's classification system

I. Plaster cast immobilisation

II. Defects < 3 cm→ end to end repair

III. Defects 3-6 cm→ debridement of tendon ends, tendon graft/flap +/- augmentation

IV. Defect >6 cm→ gastrocnemius recession, a free tendon graft and/or synthetic tendon graft

Myerson MS. Achilles tendon ruptures. Instr Course Lect. 1999; 48:219-30.

Kuwada GT. Classification of tendo Achillis rupture with consideration of surgical repair techniques. 1990; J Foot Surg 29(4):361-5.

Chronic rupture of the Achilles tendon

Whatever we do

- We want to prevent problems and complications

Chronic rupture of the Achilles tendon

Operative management

Less invasive techniques

- **Peroneus Brevis transfer**

  Carmont MR, Maffulli N. Less invasive Achilles tendon reconstruction. BMC Musculoskelet Disord. 2007; 8:100.

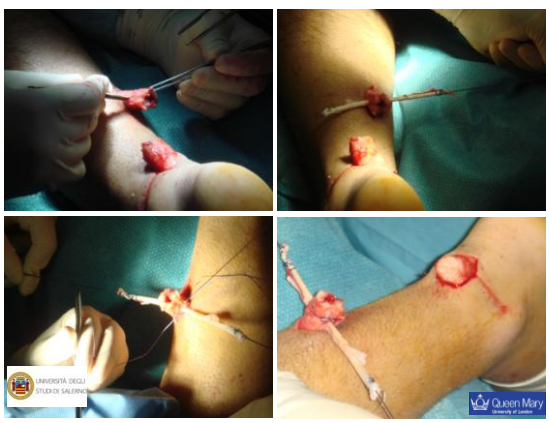
- **Ipsilateral free semitendinosus tendon graft transfer**

  Maffulli N, Longo UG, Gougoulias N, Denaro V. Ipsilateral free semitendinosus tendon graft transfer for reconstruction of chronic tears of the Achilles tendon. BMC Musculoskelet Disord. 2008; 9:100.

Chronic rupture of the Achilles tendon

Ipsilateral free semitendinosus tendon graft transfer

Maffulli N, Longo UG, Gougoulias N, Denaro V. Ipsilateral free semitendinosus tendon graft transfer for reconstruction of chronic tears of the Achilles tendon. BMC Musculoskelet Disord. 2008; 9:100.











Chronic rupture of the Achilles tendon

Postoperative management

- **Immediate weight bear on metatarsal heads with crutches**
- **Mobilise toes against resistance**
- **2/52 : Walker with heel raises (remove one every other week); WB as able**
- **Physiotherapy:**
  - **Prevent dorsiflexion of the ankle**
  - **Focus on propioception, plantar-flexion, inversion and eversion**
- **8/52: discard walker; learn to walk properly**

Maffulli N, Tallon C, Wong J, Peng Lim K, Bleakney R. No adverse affect of early weight bearing following open repair of acute tears of the Achilles tendon. J Sports Med Phys Fitness. 2003; 43(3):367-79.

Maffulli N, Tallon C, Wong J, Lim KP, Bleakney R. Early weightbearing and ankle mobilization after open repair of acute midsubstance tears of the Achilles tendon. Am J Sports Med. 2003; 31(5):692-700.

Queen Mary University of London

Chronic rupture of the Achilles tendon

Postoperative management

- **Intensive mobilisation**
- **Prevent excessive dorsiflexion**
- **Gradual return to normal activities over 6 to 9/12**

Less-Invasive Reconstruction of Chronic Achilles Tendon Ruptures Using a Peroneus Brevis Tendon Transfer

The American Journal of Sports Medicine, Vol. 38, No. 11

Nicola Maffulli,*† MD, MS, PhD, FRCS(Orth), Filippo Spiezia,‡ MD, Umile Giuseppe Longo,‡ MD, and Vincenzo Denaro,‡ MD

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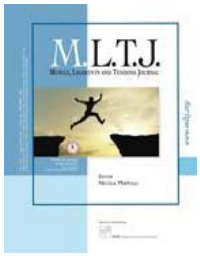
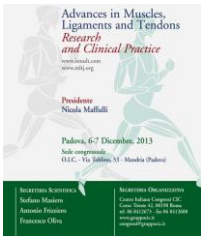
Chronic rupture of the Achilles tendon

Conclusions

- Chronic ruptures of tendo Achillis are uncommon but debilitating.
- The choice of management is partly guided by the size of the tendon defect with the optimal management likely being surgical.
- **Many different techniques can be used for reconstruction.**
- Less invasive techniques provide similar results to those obtained with open surgery, with decreased perioperative morbidity, decreased hospital stay, and reduced costs

If you wish to know more …






CURRENT CONCEPTS IN ORTHOPAEDICS
ACHILLES TENDON RUPTURE
CURRENT CONCEPTS
Thank you
Editors:
C. Niek Van Dijk
Jon Karlsson
Nicola Maffulli
Hajo Thermann
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Achilles rupture
- non-surgical augmentation

James Calder TD, MD, FRCS(Tr & Orth), FFSEM(UK)

Chelsea & Westminster Hospital NHS Trust, London

The Fortius Clinic, London
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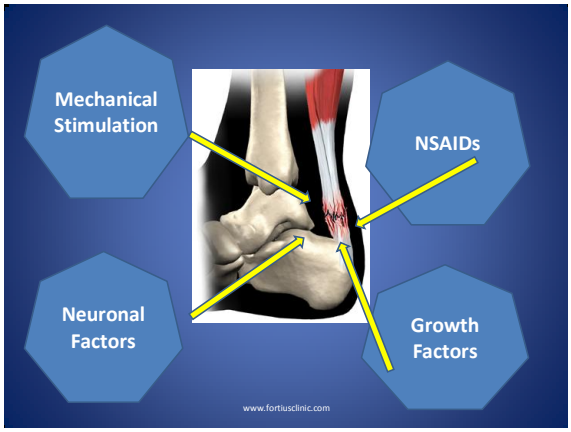
fortius clinic



Mechanical Stimulation

Activates myofibroblasts

Lack of stimulation detrimental

+ve effects in animals:
- External fixators
- Disarticulated limbs

www.fortiusclinic.com

Mechanical Stimulation

Botulinum group:
Force to failure ↓30% @ 2/52

Stimulated group:
Callus larger and stronger

Virchenko, Asenberg; Acta Orthop 2006

Increased activity – shortening of tendon callus (myofibroplastic)

Ackermann, Calder; Current Concepts 2008

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Mechanical Improvements?

- Intermittent pneumatic compression
  - wound healing
  - fracture healing
- Action:
  - ↑neuro-vascular in-growth
  - 2x expression sensory neuropeptides
  - ↑ tissue perfusion

→ speeds fibroblast
→ proliferation/collagen organisation

Dahl et al, J Orthop Res 2007

www.fortiusclinic.com

Evaluation of recovery – ultra-high resolution ultrasound

- 600 axial images/0.2mm
- Reconstructed saggital &
- coronal planes
- Pixel brightness correlates with intact, discontinuous, fibrillous, cellular and fluid

Dr Hans van Schie (Netherlands)

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NSAIDs

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NSAIDs

Platelets
Leucocytes
Monocytes
Lymphocytes

Eicosanoids
Cytokines
Nitric Oxide
Growth Factors

Chemotaxis
Vasodilation
Angiogenesis
Protein synthesis

Macrophages
Fibroblasts
Myofibroblasts
Endothelial Cells
Mast Cells

Collagen synthesis

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NSAIDs

Blood-derived Cells

In...ory Me...ors

Cox inhibitors

- ↓ 1/3 fibrous strength
- ↓bone-tendon strength in PT
- **effect lasts 2/52**

Magra, N Clin J Sp Med 2006
Ferry, Am J SP Med 2007
Virchenko, Am J Sp Med 2004

HOWEVER

Start day 6 (inflammatory phase over)

- +ve effect on mech properties
- thinner / stronger
- celecoxib improves tendon healing

Forrester, J Tr-injury inf crit care 1970
Forslund, Act Orthop Scand 2003

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Growth Factors

Many Implicated
– delivery & short ½ life

Growth and Differentiation Factors (GDF)
Part of BMP family

Cartilage Derived Morphogenic Protein (CDMP)

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Growth Factors

Many Implicated
– delivery & short ½ life
- GDF 5 & 6 on collagen sponges
- ↑ tensile strength
- dose-dependent

Aspenberg, Acta Orthop Scand 1999

www.fortiusclinic.com

Growth Factors

Many Implicated
– delivery & short ½ life
- GDF-5 coated polyglactin suture

- 80 rats, Achilles tendon
Rickert, Growth Factors 2001

- 44 rabbits, zone II flexor
Henn, J Hand Surg 2010

- tendons thicker and stronger at 1,2 & 4 weeks

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Growth Factors

Many Implicated – delivery
CDMP1,2 or 3 injected into haematoma @ 6hrs

- 30% ↑ tensile strength in rat
  Forslund, J Orth Res 2003
- 65% ↑ tensile strength in rabbit at 14 days
- No difference at 28 days
  Virchenko, J Med Sci Sports 2005

Useful for early rehabilitation?

Platelet Rich Plasma

- PRP injection @6hrs
  ↑strength 30% up to 3/52
  Aspenberg Acta Orthop Scand 2004
- rhPDGF-BB increases strength in rat model
  Shah, J Orth Res 2012
  Virchenko Act Orthop 2006
- Relies upon mechanical stimulation
  - Early benefit
  - Botox abolishes PRP effect @ 2/52

Short-lived proliferative response allows mechanical stimulation to begin earlier?

Platelet Rich Plasma

- Thrombin alone
  - ↑10% strength
- PRP gel with activated thrombin have combined effect
  - ↑42% strength
    Virchenko Act Orthop 2006
- PRP gel with neutralised thrombin
  - ↑22% strength

PRP - Human models

Schepull AJSM 2011

- No effect on strength of repair

However:

- 17 x physiological concentration of platelets (?overstimulation)
- Very high inter-patient variability (confounding variables at play?)

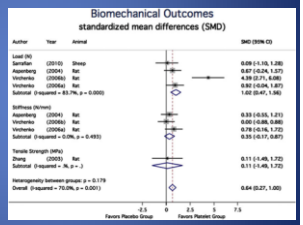
Sanchez AJSM 2007

- Faster healing
- Less thickening of tendon repair
- Higher levels of growth factors in wound edges
- Supports earlier animal work and also work on ACLs (faster healing and greater maturity)
- Cross-over with animal models and other anatomical areas

PRP overall evidence

Systematic review

- No effect in tendinopathy
- Medium – large effect in rupture
- Enhanced scar effect?
- Consistent improvement in biomechanical properties 0.5 SD across all animal models



Sadoghi, J Orth Res 2013

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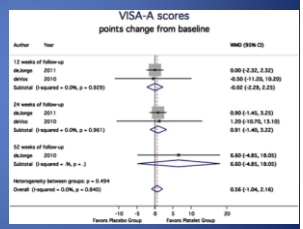

Sadoghi, J Orth Res 2013

PRP – questions?

- Which PRP?
  - ? Too many variables
  - Internal variation (day to day)
  - Different concentrations
  - Bone marrow derived stem cells possibly superior

Okamoto, JBJS(A) 2010
Chang, JBJS(A) 2007

?Bucket chemistry!

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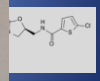
Thrombo-embolism

- Continuous LMWH
  - ↓33% strength
- Injection LMWH twice daily
  - **No effect**
- Long-acting thrombin and factor Xa inhibitors
  - ?cause for concern
  - ?intermittent use of LMWH OK

Dal

roxaban



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Neuropeptides

- Substance P (SP)
  - Gives initial boost to tendon healing
  - Accelerates reparative phase
- Injection of SP into paratenon after tendon repair in rats
  - enhances fibroblast aggregation at 1st week (no difference after this)
  - collagen orientation faster from 2nd week

Burssens, FAI 2005

- Increase tensile strength of Achilles repair by 100%

Steyaert, Arch Phy Med Rehab 2006

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Neuropeptides

- Nerve Growth Factor
- In rats MCL
  - ↑Angiogenesis
  - ↑Nerve in-growth
  - ↑Mechanical strength 55%

Mammotto J Orth Res 2008

So what does this mean to the practical orthopaedic surgeon today?

- Use mechanical stimulation
  - Early wt-bear
  - Electrical calf stimulator?

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  - Electrical calf complex?
- NSAIDs not for 1/52 post injury (beneficial from 1/52)

So what does this mean to the practical orthopaedic surgeon today?

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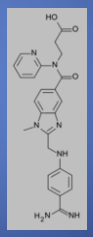
- Significant risk of VTE but consider problems with Xa inhibitors for thrombo-embolic prophylaxis



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So what does this mean to the practical orthopaedic surgeon today?

- Use mechanical stimulation
  - Early wt-bear
  - Electrical calf complex?
- NSAIDs not for 1/52 post injury
  (beneficial from 1/52)
- Significant risk of VTE but consider problems with Xa inhibitors for thrombo-embolic prophylaxis
- Current evidence appears to support PRP or even concentrated bone-marrow aspirates

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Achilles rupture - non-surgical augmentation

James Calder TD, MD, FRCS(Tr & Orth), FFSEM(UK)

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fortius clinic

University Campus Bio-Medico of Rome
Department of Trauma and Orthopaedic Surgery
Head Prof Vincenzo Denaro

Percutaneous Achilles Repair

Presenter: Umile Giuseppe Longo *MD, MSc, PhD*

Conflicts of interest

No conflicts to declare

Achilles tendon ruptures

- **INCIDENCE**
  - Annual average of 5 to 18 ruptures per 100,000 people
  - More common in males in the third or fourth decade of life
- **ETIOLOGY**
  - Most acute AT ruptures are traumatic
  - Possible occult degeneration

ATR Summary of Recommendations: number 8

AAOS
AMERICAN ACADEMY OF ORTHOPAEDIC SURGEONS
THE DIAGNOSIS AND TREATMENT OF ACUTE ACHILLES TENDON RUPTURE
GUIDELINE AND EVIDENCE REPORT

- Open, limited open and percutaneous techniques are options for treating patients with acute Achilles tendon rupture.
- Strength of Recommendation: **Weak**

Achilles tendon ruptures

- Operative management of acute AT ruptures significantly reduces the risk of rerupture compared with nonoperative treatment
- Open operative treatment is associated with a significantly higher risk of other complications
- Operative risks may be reduced by performing surgery percutaneously

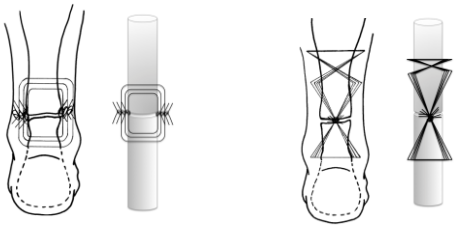
THE COCHRANE COLLABORATION®

Khan RJ et al Cochrane 2010

Percutaneous Achilles tendon repair

- **Several percutenaous techniques available**
- **Pros**
  - Faster recovery time
  - Shorter hospital stays
  - Improved functional outcomes
- **Cons**
  - Sural nerve damage

Biomechanics of minimally invasive techniques for Achilles tendon



There were no differences in mean strength of suture, mean maximum load, mean failure elongation, tension value, mean stiffness and mode of failure

Longo UG, Forriol F, Campi, S, Maffulli N and Denaro V KSSTA (2012);20(7):1392-7

Percutaneous Achilles tendon repair

- 1 incision over the defect
- 4 longitudinal stab incisions 6 cm proximal to the palpable defect

Carmont and Maffulli KSSTA (2008) 16:199-203

Percutaneous Achilles tendon repair

Carmont and Maffulli KSSTA (2008) 16:199-203

Percutaneous Achilles tendon repair

Carmont and Maffulli KSSTA (2008) 16:199-203

Percutaneous Achilles tendon repair

Carmont and Maffulli KSSTA (2008) 16:199-203

Percutaneous Achilles tendon repair

- The ankle is held in full plantar flexion, and in turn opposing ends of the Maxon thread are tied together

Carmont and Maffulli KSSTA (2008) 16:199-203

Percutaneous Achilles tendon repair

- At 2 weeks, the back shell of the cast is removed
- The front shell remains in place for 6 weeks to prevent forced dorsiflexion of the ankle.

Carmont and Maffulli KSSTA (2008) 16:199-203

ATR Summary of Recommendations: number 6

AAOS

THE DIAGNOSIS AND TREATMENT OF ACUTE ACHILLES TENDON RUPTURE GUIDELINE AND EVIDENCE REPORT

- In the absence of reliable evidence, it is the opinion of the work group that although operative treatment is an option, it should be approached more cautiously in patients with diabetes, neuropathy, immunocompromised states, age above 65, tobacco use, sedentary lifestyle, obesity (BMI >30), peripheral vascular disease or local/systemic dermatologic disorders.
- Strength of Recommendation: **Consensus**

Percutaneous Achilles tendon repair

Clin Orthop Relat Res
DOI 10.1007/s11999-009-0944-1

SYMPOSIUM: RECENT ADVANCES IN FOOT AND ANKLE SURGERY

Favorable Outcome of Percutaneous Repair of Achilles Tendon Ruptures in the Elderly

Nicola Maffulli MD, MS, PhD, FRCS(Orth),
Umile Giuseppe Longo MD, Mario Ronga MD,
Anil Khanna MRCS, MS(Orth), Vincenzo Denaro MD

- 26 men and 9 women with a mean age of 73.4
- Follow up 49 months
- The ATRS had a postoperative average rating of 69.4 ± 14 (range, 56–93)
- Two patients experienced a re-rupture (protected the operated limb in the cast for only 2 and 4 weeks after surgery, respectively)

Maffulli N, Longo UG, Ronga M, Khanna A, Denaro V CORR 2011

Percutaneous Achilles tendon repair

- 3 patients had superficial infection
- 3 patients had hypesthesia over the area of distribution of the sural nerve
- The hypesthesia resolved over 6 months in two of the three patients.
- In the third patient, the hypesthesia persisted but did not interfere with the patient's activities of daily living or with the wearing of shoes

Maffulli N, Longo UG, Ronga M, Khanna A, Denaro V CORR 2011

Percutaneous Achilles tendon repair

Arch Orthop Trauma Surg
DOI 10.1007/s00402-010-1087-0
ORTHOPAEDIC SURGERY

Achilles tendon ruptures in diabetic patients

Nicola Maffulli · Umile Giuseppe Longo · Gayle D. Maffulli · Anil Khanna · Vincenzo Denaro

- 39 subjects
- ATRS score: post-operative average rating of 70.4 ± 13 (range 55–92).
- All patients were able to fully weight bear on the operated limb by the end of the eighth post-operative week.
- Eight patients suffered from a superficial infection of the surgical wound.

Maffulli N, Longo UG, Maffulli GD, Khanna A, Denaro V AOTS 2011;131(1):33-8

Percutaneous Achilles tendon repair

Foot & Ankle International
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DOI: 10.3113/FAI.2011.0008

Achilles Tendon Ruptures in Elite Athletes

Nicola Maffulli, MD, MS, PhD, FRCS(Orth); Umile Giuseppe Longo, MD; Gayle D. Maffulli, BA(Hons); Anil Khanna, MBBS, MRCS; Vincenzo Denaro, MD

- Seventeen elite athletes
- Average time to return to full sport participation was 4.8 ± 0.9 months
- Two of the 15 elite athletes on whom we have full data suffered from a superficial infection of the surgical wound

Maffulli N, Longo UG, Maffulli GD, Khanna A, Denaro V FAI 2011;32(1):9-15

Conclusions

- Similar results to those obtained with open surgery
- Decreased perioperative morbidity
- Decreased duration of hospital stay
- Reduced costs
- Randomized controlled trials are required

Thank You!

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Department of Trauma and Orthopaedic Surgery