

## PIP Replacement Dead, Dying or in Good Health



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Wessex Hand Course May 2015

[www.handsurgery.co.uk](http://www.handsurgery.co.uk)




UNIVERSITY OF Southampton School of Medicine





University Hospital Southampton NHS Foundation Trust


## Conflict of Interest





- Ascension Orthopaedics 2004-12
  - Speaker Panel
  - Honoraria and travel expenses
  - Several occasions

## PIP failure






- Trauma
- Infection
- Osteoarthritis
- Inflammatory arthropathy

## Treatment



- Non Operative
  - Wait and see
  - Analgesics
  - Splints
  - Injections
- Operative
  - Neurectomy
    - Don't forget this one!
  - Autograft
    - Vascularised transfer
  - Fusion
  - Replacement

## What operation for what finger?



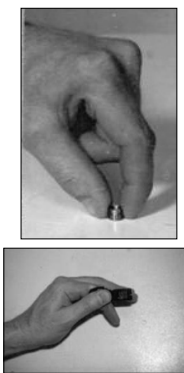
## Fusion or Joint Replacement

- Index and middle
  - Fusion
  - Replace
- Ring and little
  - Replace

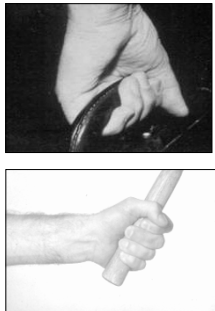
### Finger function Index and Middle

- ☞ Pre-requisites
  - Stable pinch against the thumb
  - MCPJ
    - Stable radial collateral ligament
    - Pain free
    - Flexion 80°
  - PIPJ
    - Stable radial collateral
    - Pain free
    - Fixed flexion 15-25 degrees
  - DIPJ
    - Stable
    - Pain free
    - Slight supination



### Finger function Ring and little

- ☞ MCPJ
  - full flexion and extension
  - less need for collateral stability
- ☞ PIPJ
  - full flexion and extension
  - less need for collateral stability
- ☞ DIPJ
  - ditto



### Types of PIP replacement

- ☞ Silastic Hinge
- ☞ Anatomic joints

### Silicone PIPJ Results

- ☞ Swanson 1985 JHS 10A 796-805
  - N =424
  - FU =5.1 years
  - 98.3% pain free
  - ROM 57 degree arc
- ☞ Takiwaga 2004 JHS 29A 785-795
  - N =70
  - FU =6.5 years
  - ROM 30 degree arc
  - Survivorship 98% 2 years, 80% 10 years, 49% 16 years
  - BUT: 11/70 fractured, 16/70 ? Fracture, 4/70 dislocated, 35/70 subsided, 32/70 cystic change

### Silicone for OA

- ☞ Recent paper
  - Namdari S and Weiss A-P 2009 JHS;34A: 292-300. Anatomically neutral silicone small joint arthroplasty for osteoarthritis
- ☞ Patients
  - 13 MCPJ, 16 PIPJ
  - 4 years (1-8)
- ☞ Outcome
  - MHQ 88 MCP, 87 PIP
  - 90% satisfaction
- ☞ Arc
  - MCP 65 degree
  - PIP 61 degree

### Problems with Silicone

- ☞ May fracture
- ☞ Relatively unstable and do not resist soft tissue forces well
  - Minamikawa et al JHS 1994 19A 1050-1054
- ☞ Silicone Synovitis in PIPJ
  - Pellegrini and Burton 1990.15A 194-209
    - 35% periarticular erosions at 2 years
    - 20% intramedullary resorption at 4 years

Replace Index PIP  
Silastic is not stable....

Hence a search for  
a *stable anatomic* joint

Design Challenge

- ☞ More challenging than THR, TKR
  - Complex bone contours
  - Complex soft tissue envelope
  - Adjacent digits
    - Kinetic Chain
    - Intrinsic muscles
    - Oblique retinacular ligament

Design

- ☞ Should be anatomically contoured
  - Proper placement of centre of rotation
  - Accurate offset of stem on head
- ☞ Retain soft tissues
  - Minimal resection
  - Preserve extensor balance

Early Designs

- ☞ Hinge
  - Brannan and Klein 1959
    - Hinged titanium
    - Loosening
- ☞ Flexible twin stem
  - Flatt 1961
    - Erosion, metallic debris
- ☞ Metal-Plastic
  - Several authors, 1971 onwards
    - Breakage, erosion, loosening
- ☞ Ceramic Alumina Hinge
  - Doi et al 1983 ?results
- ☞ Osseointegrated implants
  - Moller et al JHS 29A:32-38

Catastrophically failed design

*A Report on the Early Failure of the LPM Proximal Interphalangeal Joint Replacement*  
**J. L. HOBBY, S. EDWARDS, J. FIELD and G. GIDDINS**  
 Journal of Hand Surgery (European Volume), Vol. 33, No. 4, 526-527 (2008)

Favourable looking anatomic designs

- ☞ PIPR
- ☞ Avanta SRA
- ☞ Ascension Pyrocarbon



Avanta SRA



Surface Replacement Arthroplasty

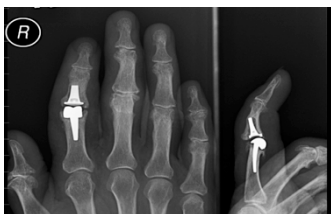
- ☞ Avanta SRA
  - Mayo Clinic
- ☞ Materials
  - Cobalt Chrome
  - UHMWPE



Results Avanta SRA  
Lindscheid et al 1997;22A:286-298

- ☞ PIPJ
  - N 66, cemented
  - FU 4.5 years average
  - ROM increased from 53 to 47 degrees
  - 5/66 persistent instability
  - 11/66 secondary procedures
- Later review:40 good, 22 fair, 17 poor

Avanta SR  
Johnstone 2008 JHS 33A:726



- Migration 14/43 (33%)
- Revision 7/43 (17%) at 3yrs

Avanta SR  
Jennings 2008 JHS 33A:1565

- ☞ Series
  - N= 43
  - FU 12 to 72 months (mean 37M)
- ☞ Outcome
  - 60% v satisfied; 28% fairly satisfied
  - Average arc 56 degrees (64 degrees at 4 yr fu)
  - 11/43 revised
    - due to no cement in 10/11
    - Satisfactory cemented revision

### Avanta SR

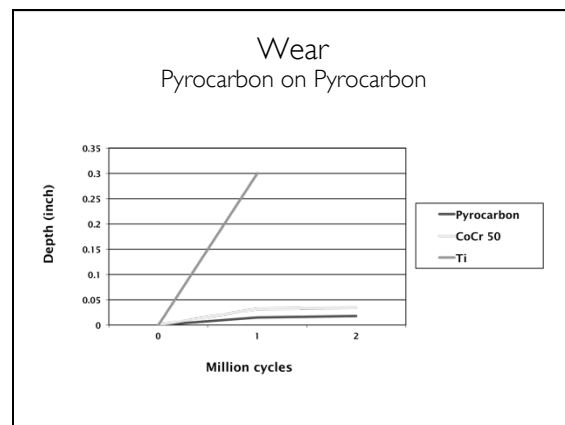
Jennings 2013 JHS 40:469-73

- ☞ Series
  - N= 39
  - FU (mean 9.3 years)
- ☞ Outcome
  - 83% v satisfied; 17% fairly satisfied
  - Average arc 58 degrees (pre-op 57)
  - 11/43 revised (26%)
    - due to loosening no cement in 10/11
    - Satisfactory cemented revision
    - no revisions since 50 month follow up



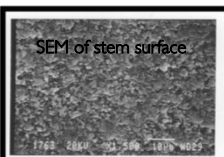

### Portrayed advantages of pyrocarbon

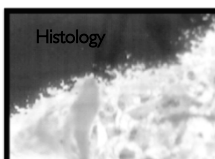

- ☞ Glamorous Pedigree
  - Nuclear industry
  - Heart valves
- ☞ Strong
- ☞ Reduced wear against cartilage and bone
- ☞ Inert
- ☞ Highly wear resistant against itself
- ☞ Elastic modulus similar to bone
- ☞ Anatomical manufacture

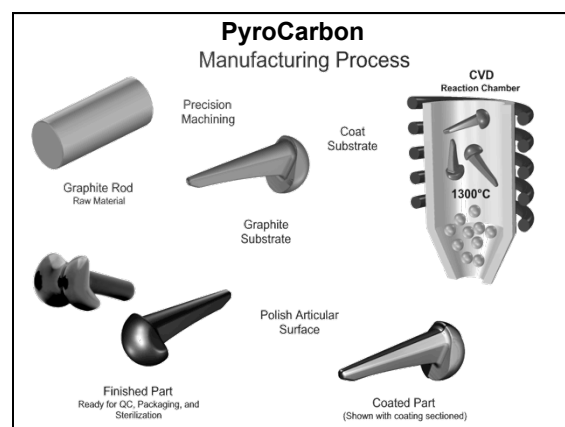


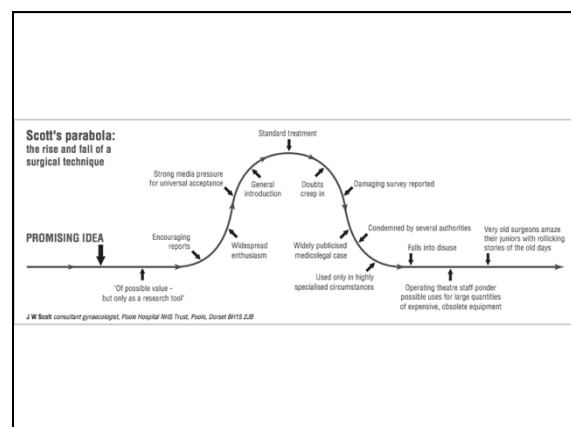
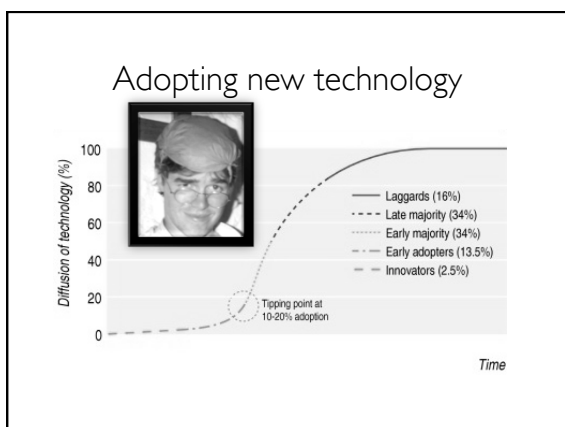
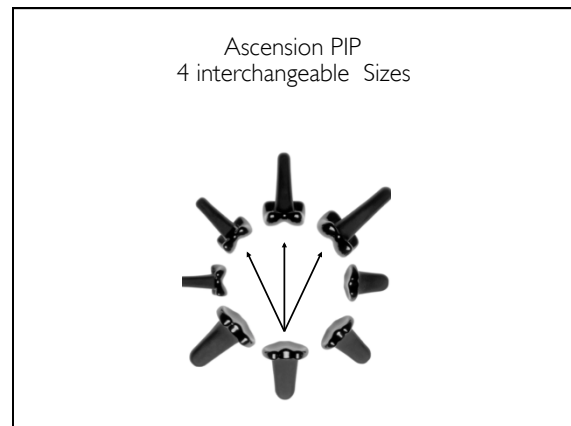
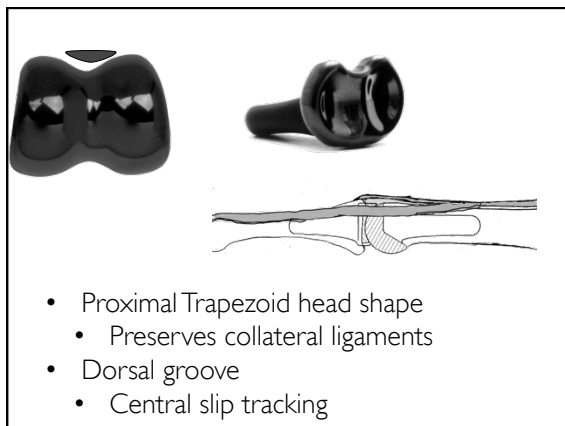
### Biocompatibility

- ☞ Inert
- ☞ Bone upgrowth





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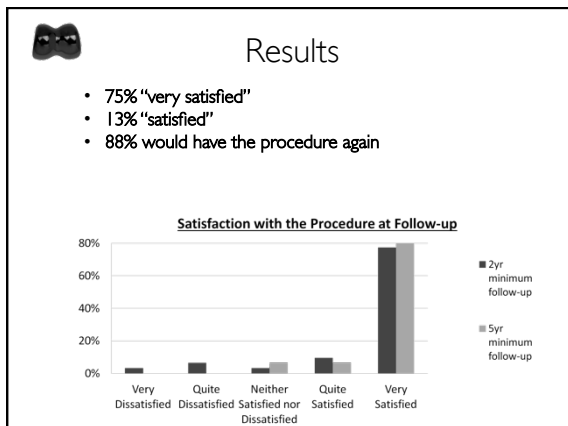
Medium-term outcomes of pyrolytic carbon proximal interphalangeal joint arthroplasty - a service evaluation FESSH Paris 2014

D Warwick Z Borton, T Koç, E Melikyan, D Hargreaves,

Pyrocarbon PIPJ

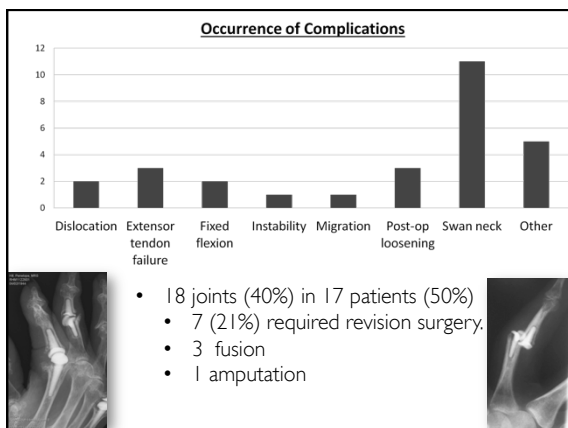
- Minimum follow-up: 2 years
- 45 joints, 34 patients
- Mean age: 64.6 years (range 33-79)

Zakk Borton



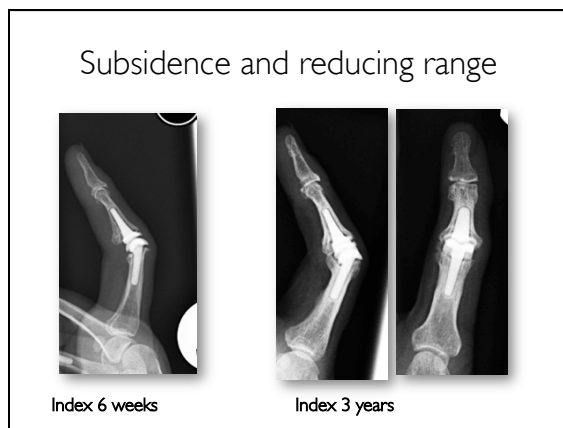
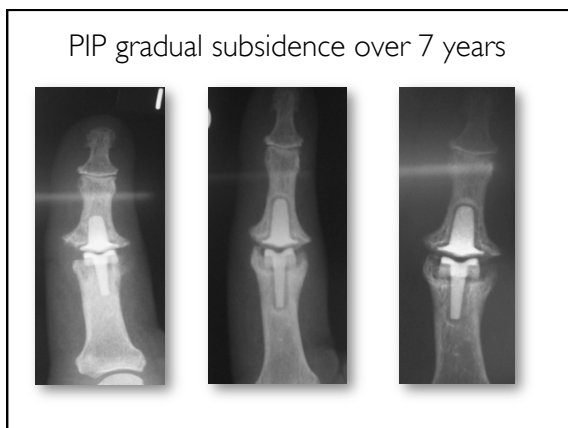
### Results

- 96% reported that the surgery
  - "made [their pain] a lot better"
  - median pain score: 0/10 (range 0-7)
- Stiffness
  - common complaint
- The positive effect of the procedure was often limited by other untreated joints of the hand.



### "Osseointegration"

- This does not usually happen
- Lucent line
  - very thin line post op is the coating
  - The lucent line gets bigger with time as the implant wobbles



Late failure (6 years)



Malposition (Rotation)



Disaster....



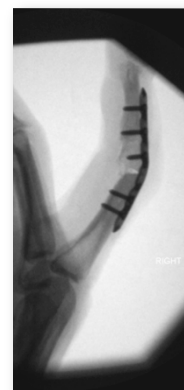
- ☞ Dominant PIPJ
- ☞ Marked loss of bone at base of P2



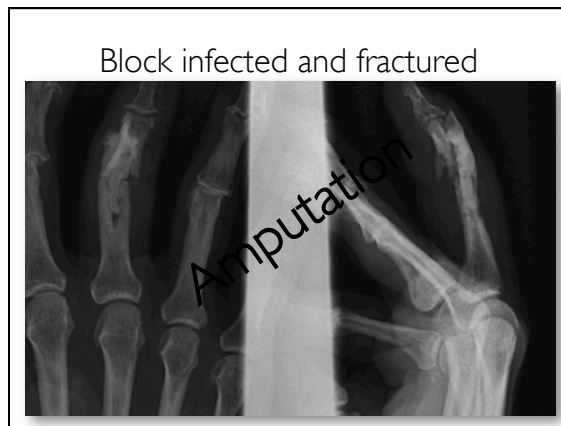
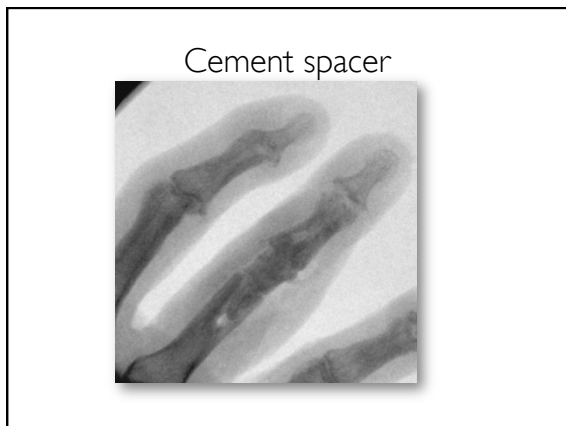
3 months post op



Iliac crest  
peg







Author	Year	N	FU (n)	revision	comps	ROM pre	ROM post	Pain (10)	Migration	Sats	Squeak	Abandon
Tintin Stern JHSA	2006	18	13 ave	?	7			1.7		9/16		44%
Branam KHSA	2007	19	19 (6-36)	?	4			50% pain free		81%		42%
Bravo JHSA	2007	30	37 (27-46)	8%	40%	-	47	1	40%	8/10	-	
Nurley JHSA	2006	7	17 (12-23)	28%		32	30	4 (pre 6)				Abandon
Herron JHGB	2006	14	19 (12-27)	6%				1.3 (pre 7.6)				
Wip JHSA	2010	53	24 (2-60)	11%				0.4				
Watts	2012	70	60 (24-79)	13%	69%	25	30	0	64%	8/10		4%
Reisner	2014	15	9.7 ave			36	29	0.7	66%			Abandon
Sweets	2011	31	55 ave	16%	40/31	57	31	3	32%	7/10		35%
Tagli	2013	21	>5yrs	11%		19	54	0				Abandon
McGuire	2012	57	28/57	9%		30	66	"Excellent"	30%	85%		15
Hutt	2012	18	2-8.8 yrs	11%		40	45	0				
Heers	2013	13	6-9 yrs	15%		46	58		7/13			Abandon
Ono	2012	13	>2yrs ave (44)		43%							
Chung	2009	21	12m			40	38					22%
Mashhad i	2012	24	>3yrs	34%	36	46	0.9	0				18%

THE JOURNAL OF BONE & JOINT RECONSTRUCTION

**INSTRUCTIONAL REVIEW: UPPER LIMB**

**Proximal interphalangeal joint replacement in patients with arthritis of the hand**

A META-ANALYSIS

J. Adams, C. Ryall, A. Pandyan, C. Metcalf, M. Stokes, S. Bradley, D. J. Warwick

From Musculoskeletal Biomedical Research Unit, University of Southampton, Southampton, United Kingdom

We systematically reviewed all the evidence published in the English language on proximal interphalangeal joint (PIPJ) replacement, to determine its effectiveness on the function of the hand and the associated post-operative complications. Original studies were selected if they reported clinical outcome with a minimum of one year's follow-up. Quality was assessed using the Cowley systematic review criteria modified for finger joint replacements. Of 319 articles identified, only five were adequately reported according to our quality criteria; there were no randomised controlled trials. PIPJ replacements had a substantial effect size on hand pain of -23.2 (95% confidence interval (CI) -27.3 to -19.1) and grip strength 1.2 (95% CI -10.7 to 13.1), and a small effect on range of movement 0.2 (95% CI -0.4 to 0.8). A dorsal approach was most successful. Post-operative loosening occurred in 10% (95% CI 3 to 30) of ceramic and 12.5% (95% CI 7 to 21) of pyrocarbon replacements. Post-operative complications occurred in 27.8% (95% CI 20 to 37). We conclude that the effectiveness of PIPJ replacement has not been established. Small observational case studies and short-term follow-up, together with insufficient reporting of patient data, functional outcomes and complications, limit the value of current evidence. We recommend that a defined core set of patients, surgical and outcome data for this intervention be routinely and systematically collected within the framework of a joint registry.

J Bone Joint Surg 2012; 94B: 1035-40

Summary Pyrocarbon PIPJ

- Small studies
- Short term results only
  - 12m - few years
- 70-80% satisfaction
- 20-45% complications
  - 10 to 20% revision
  - stiffness, squeaking, deformity
  - Migration and loosening high
- Movement
  - does not improve
  - 40-50 degree arc
- Minimal pain

**SCIENTIFIC ARTICLE**

### Pyrolytic Carbon Hemiarthroplasty in the Management of Proximal Interphalangeal Joint Arthritis

Kurt Petersson, MD, PhD, Anders Amilon, MD, Marco Rizzo, MD

**Purpose:** To review clinical, subjective, and radiographic results of pyrocarbon hemiarthroplasty for proximal interphalangeal (PIP) joint arthritis.

**Methods:** A total of 42 fingers in 38 patients underwent PIP joint hemiarthroplasty between 2005 and 2011. Preoperative diagnoses included 28 with osteoarthritis or posttraumatic arthritis and 10 with inflammatory arthritis. Average age at the time of surgery was 56 years. Digits treated included: index (10), middle (20), ring (9), and little (3). Average follow-up was 4.6 years (minimum, 2 y).


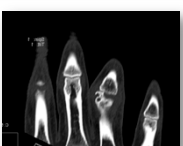
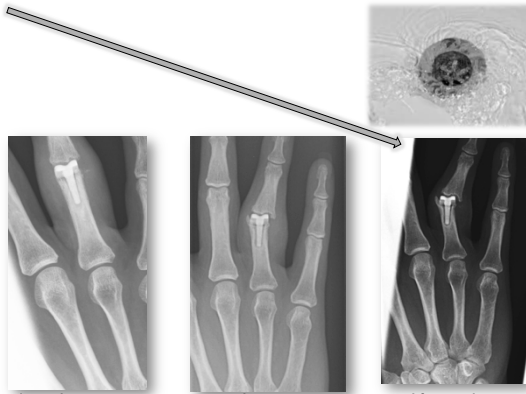
**Results:** There was considerable improvement in patient satisfaction measures including Canadian Occupational Performance Measure for both performance and satisfaction and Disabilities of the Arm, Shoulder, and Hand and visual analog scale pain scores. There was no significant change in motion or grip and pinch strength after surgery. Four joints were revised for failure: 3 underwent arthrodesis and 1 was converted to a silicone PIP joint arthroplasty. Radiographic outcomes in surviving implants demonstrate a Sweets and Stern grade 0 in 37 implants and grade 3 in 1.

**Conclusion:** Pyrocarbon hemiarthroplasty appears to be a viable alternative to total joint arthroplasty in the treatment of PIP joint arthritis. Clinical and patient satisfaction outcomes compared favorably with published outcomes of arthroplasty. Radiographic outcomes of PIP joint hemiarthroplasty were encouraging with respect to implant position and loosening. Compared with total joint arthroplasty, proximal hemiarthroplasty is a simple procedure that preserves more bone stock and would allow for better success of salvage options such as arthrodesis and revision arthroplasty. (*J Hand Surg Am.* 2015;40(3):462-468. Copyright © 2015 by the American Society for Surgery of the Hand. All rights reserved.)

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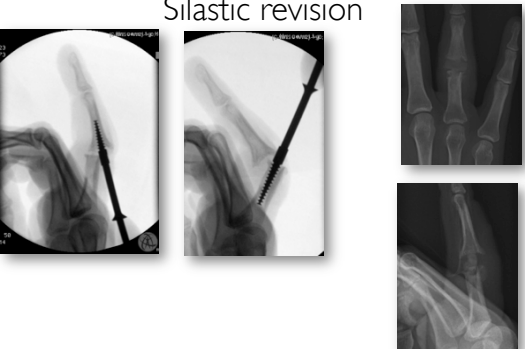
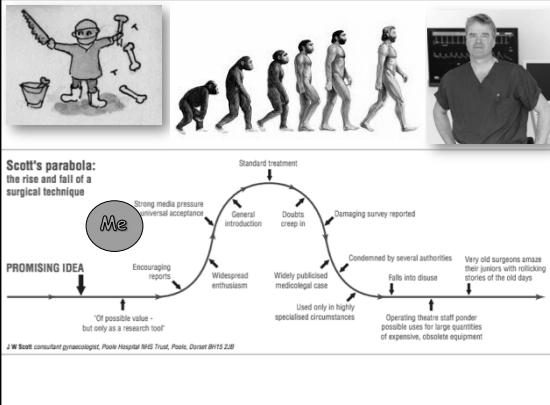
### Pyrocarbon PIP in Trauma

- ⊖ Theoretical advantage
  - isoelastic
  - minimal wear
- ⊖ Patient
  - 23 yr lady

6 weeks      1 year      18 months

### Silastic revision


**Scott's parabola: the rise and fall of a surgical technique**

**PROMISING IDEA** (Me) → Encouraging reports → Widespread enthusiasm → General introduction → Standard treatment → Durable creep in → Damaging survey reported → Condemned by several authorities → Falls into disuse → Very old surgeons amaze their juniors with relicting stories of the old days

Notes: Strong media pressure, universal acceptance; Widely publicised medicolegal case; Used only in highly specialised circumstances; Operating theatre staff ponder possible cases for large quantities of expensive, obsolete equipment.

J W Scott consultant geriatrician, Stoke Hospital NHS Trust, Poole, Dorset BH15 2JB

### Don't throw the baby out with the bathwater



### My current paradigm


**Chan et al 2013** Pyrocarbon versus silicone proximal interphalangeal joint arthroplasty: a systematic review. *Plast Reconstr Surg.* 131:114.

**Daeke et al (2014)** A prospective, randomized comparison of 3 types of proximal interphalangeal joint arthroplasty. *J Hand Surg Am.* 37(1770-9).

☞ Revision Rates

Silastic	11%
Pyrocarbon	39%
Titanium Polythene	27%

*"Based on the available low level of evidence, pyrocarbon arthroplasty does not demonstrate clear superiority over silicone implants. In fact, there is concern about the complication rates of these implants."*




### My current paradigm

☞ Index and middle


- Anatomical replacement
- Consent
  - 1/3 do well, 1/3 are OK, 1/3 are disappointing
  - If it fails then fusion anyway
- Fusion
  - if unstable/high demand

☞ Ring and little

- Silastic replacement
  - at least equivalent to pyrocarbon
  - no appreciable collateral stress
  - Cheaper



### Anatomic Middle Silastic Ring



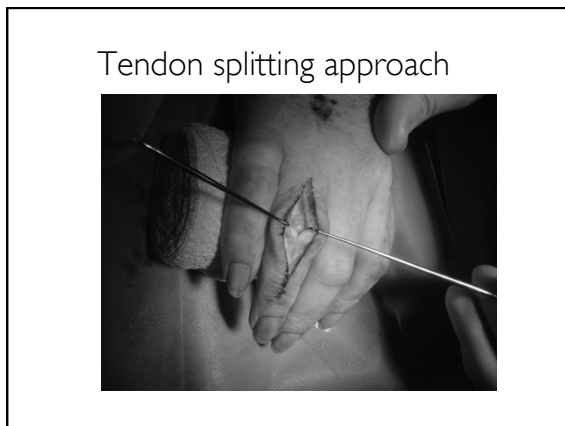
### Surgical Techniques

### Key points

- ☞ Preserve collaterals
  - stability
- ☞ Preserve length
  - Extensor mechanism balance
- ☞ Maintain central slip integrity
- ☞ Crucial to get Centre of Rotation correct
  - Collaterals,
  - Intrinsic muscles -Lateral bands
  - Central slip
  - Oblique retinacular ligament

### PIP Approaches

- ☞ Lateral
- ☞ Anterior
- ☞ Dorsal



### Rehabilitation

- ☞ Early Mobilisation
  - Avoid stiffness, esp in OA
  - Good intra-operative soft tissue tension and stability
  - 3 to 4 days start active movement
  - ? Night splintage
- ☞ In weaker soft tissues
  - Splint?
  - Dynamic splint?
  - Supervised early ROM
- ☞ Oedema control

**Oxford Specialist Handbooks in Surgery**  
**Hand Surgery**  
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Wessex Hand Course May 2015

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