Research of clinical and histological supports for sensitivity of toe pulp flap in distal digital reconstruction

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Introduction

• Pulp reconstruction = real challenge
• Objective = loss of substance coverage, sensitive pulp, good trophicity
• Study goal:
  • Clinical evaluation of pulp sensitivity in fingers and toes
  • Histological analysis of finger and toe pulps mechanoreceptors density
• Establishing indications for this type of reconstruction
Material and Method

- **Clinical study**
  - 40 healthy volunteers
  - Mean age 32 years
  - Exclusion criteria: traumatic or surgical history, neurological pathology, psychiatric pathology, history of diabetes, vascular extremity history, hyperkeratosis, lack of cooperation or ability to understand the test
  - Weber and Dellon test on each thumb, index finger, 1st toe and 2nd toe pulp
Material and Method

• Histological study
  • 4 bodies of elderly subjects recently deceased (Laboratory of Anatomy Pr DUPARC - CHU ROUEN)

• Withdrawals
  • Thumb and forefinger pulp from each hand
  • External hemipulp of the 1st toe and complete pulp of the 2nd toe from each foot

• Histological sections treated by H.E.S and PS100 (pathology department Pr SABOURIN - CHU ROUEN)

• Global analysis of each slide and counting the number of corpuscles per field
Pacini corpuscle

x10

x20
Meissner corpuscle
Merkel's corpuscle
Results of clinical study

• **Weber test**
  • Finger pulp = 3.68 mm
  • Toe pulp = 9.23 mm
  • **Toe pulp has a significantly worse discrimination than finger pulp**
  • Forefinger radial hemipulp = better discriminative value than the other fingers.
• No statistical significant difference between pulp of first and second toes
Results of clinical study

- **Dellon test**
  - Finger pulp = 2.86 mm
  - Toe pulp = 8.20 mm
  - 1mm lower than Weber test
  - Significant difference between discriminative sensitivity of digital and toe pulps
Result of histological study

- **Slides Overall analysis**
  - Clear difference between samples from digital pulp and toes pulp
  - Fewer mechanoreceptors in toes than fingers
  - Morphological similar nerve termination
Comparison of thumb pulp and first toe pulp tissues in the same subject.
Result of histological study

- **Statistical analysis of cell count**
  - **Meissner corpuscle** (per linear cm of pulp)
    - Finger: 4.79
    - Toe: 1.06
    ➔ 4 x less
  - **Pacini corpuscle** (per linear cm of pulp)
    - Finger: 4.01
    - Toe: 1.49
    ➔ 3 x less
  - **Mechanoreceptor density in toes is significantly lower than fingers**
  - No difference between fingers pulp, or between toes pulp
  - Specific "histological profile" similar to fingers and toes
Discussion

- **Weber and Dellon test**
  - **Why?**
    - Easily achievable, used in medical practice, reliable for nerve regrowth follow up

- **Factors influencing results**
  - Applied pressure
  - Tests Reproducibility

- **Patient age**

- **Parameters difficult to quantify**: room temperature, patient state of mind ...
Discussion

• **Comparison with literature**
  • May (1977)
    • 50 subjects
    • 1st toe: 11.3 mm and 3 to 4 mm for thumb
  • Chu (1995)
    • 1st toe: 6.2mm and index: 2.9mm
    • After transplantation: 9.1 mm
    • **Sensitivity of a transplanted toe is close to a normal toe.**
  • Lee (2008)
    • 929 free pulp flaps
    • 8mm at one year follow up
Discussion

- **Histological study**
  - **Bolton (1966)**
    - 46 1st toes and 50 5th finger
    - *Meissner corpuscle density twice as small in first-toe pulp as in 5th-finger pulp*
  - **Wei (1999)**
    - 34 patients, 4 control samples of toe pulp
    - 0.37 / mm after transplant versus 0.94 / mm for a healthy toe
    - **On average, 40% of meissner's corpuscle survival after toe transplant compared to a normal pulp**
Discussion

- "Nerve regrowth" factor is to be taken into account
  - Microanastomosis
  - Sensitivity recovery depends on many factors:
    - Patient age, surgical technique, area vascularization, pulp rehabilitation, patient motivation
  - May alter results of sensitivity recovery
- On the contrary, local shreds
  - No vasculoneural anastomosis
  - Grafted skin has the same characteristics in mechanoreceptors and nerve ending
  - Best result on sensitivity recovery
Conclusion

• Sensitive mechanoreceptors density in toe pulps is significantly lower than in fingers
• Transfer of toe pulp = reconstruction of a digital pulp without bringing a normal sensitivity
• Limited use for contraindications of local flaps
Thank you for your attention