Reconstruction of Upper Extremity Nerves: Comparing Nerve Autograft & Processed Nerve Allograft Outcomes

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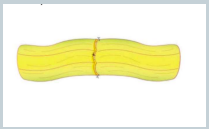
Conflicts of Interest

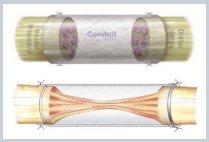
- None

Introduction

- 20 million Americans suffer from peripheral nerve injuries [1]
- 1.4 million estimated annual incidence of nerve injury [2]
- 75% peripheral nerve injuries are upper extremity [3]
- The effects can be devasting [4]

NERVE REPAIR OPTIONS





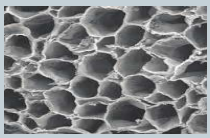
SURAL NERVE GRAFT

Disadvantages

- Limited graft length & width
- Increased morbidity
- Increased complications [5]
- Increased operative time

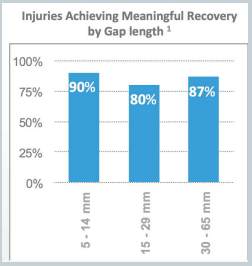
Avance® Nerve Graft

- AxoGen Inc, Alachua, FL
- Human cadaver nerve allograft
- Sterilized, decellularized
- "Off the shelf" availability
- Variety of lengths and widths
- Incorporated by host tissue
- Provides extracellular matrix scaffold



Clinical Evidence

- RANGER study
  - Registry of Avance Nerve Graft Evaluating Utilization and Outcomes for the Reconstruction of Peripheral Nerve Discontinuities
- Centralized patient database registry
- 18 centers, 36 surgeons
- Established 2007
- Report 87% Meaningful Functional Recovery



Meaningful Functional Recovery

Table 2 Muscle Strength Grading*

M0	None. No evidence of contractility.
M1	Trace. Evidence of slight contractility. No joint motion. Return of perceptible contraction of the proximal muscles.
M1+	Proximal muscles contract against gravity but intrinsics are paralyzed.
M2	Poor. Complete range of motion with gravity eliminated. Same as M1+ with perceptible intrinsic contraction.
M2+	Proximal and distal muscles are all active against gravity.
M3	Fair. Complete range of motion against gravity. Return of function in proximal and distal muscles to such a degree that all important muscles to such a degree that all important muscles are sufficiently powerful against gravity.
M4	Good. Complete range of motion against gravity with some resistance. All muscles act against strong resistance and some independent movements are possible; some intrinsic weakness.
M5	Normal. Complete range of motion against gravity wit full resistance. Full recovery in all muscles.

*[British] Medical Research Council classification.[43] Included is Highet and Sanders' modification.[45]

MFR Muscle Strength ≥ S3

Meaningful Functional Recovery

Table 1 Sensibility Grading*

S0	No sensory recovery.
S1	Recovery of deep cutaneous pain sensibility.
S2	Recovery of superificial cutaneous pain sensibility.
S2+	Same as S2, only with over response.
S3	Recovery of pain and touch sensibility with a disappearance of over response. Two-point discrimination > 15 mm.
S3+	Same as S3, only localization of the stimulus is good. Two-point discrimination 7 to 15 mm.
S4	Complete recovery. Two-point discrimination 2 to 6 mm.

*[British] Medical Research Council classification.[43] Added is MacKinnon and Dellon's modification of two-point discrimination.[44]

MFR Sensation ≥ S3

Comparison to Historical Reference Literature

Study	Nerve Injury Types	Test Article	Positive Outcomes*
RANGER® Study – Avance® Nerve Graft			
(Brooks, et al, 2012; Cho, et al, 2012)	Sensory, Mixed and Motor Nerve Injuries	Avance® Nerve Graft	87%
Nerve Autograft Studies			
Weber, et al., 2000	Sensory Nerves	Direct Repair and Autograft	86%
Kim and Kline 2001-2006	Sensory and Mixed Nerves	Direct Suture and Autograft	67-86%
Frykman and Gramyk, 1991	Sensory Nerves	Autograft for Digital Nerve Injury under 5 cm	80%
Frykman and Gramyk, 1991	Mixed Nerves	Direct Suture and Autograft	75-78%
Kallio, et al., 1993	Sensory Nerves	Autograft and Direct Repair	70%

GOALS

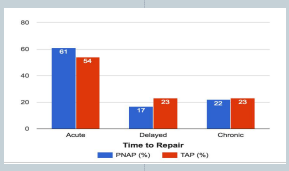
- Identify upper extremity peripheral nerve injuries reconstructed with either autologous nerve grafts or processed nerve allografts
- Assess motor and sensory functional outcomes for “Meaningful Functional Recovery”
- Analyze and compare results between populations

POPULATIONS

Processed Nerve Allograft Population	Traditional Autograft Population
• 14 patients	• 10 patients
• 18 nerves repairs	• 22 nerve repairs
• 36% Female, 64% Male	• 100% male
• Mean age: 36 years old	• Mean Age: 33 years old
○ SD ± 15	○ SD ± 7
○ Range 18 - 61	○ Range 23 - 45

POPULATIONS

Processed Nerve Allograft Population	Traditional Autograft Population
• 64% no comorbidities	• 80% no comorbidities
• 50% daily tobacco use	• 70% daily tobacco use



INJURIES

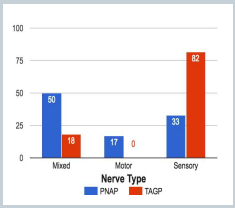
Location	PNAP (%)	TAP (%)
Hand	33	77
Forearm	44	18
Elbow	22	5
Mechanism		
Laceration	67	77
Crush	11	23
Blast	17	0
Iatrogenic	6	0
Concomitant Injury	86	90
Complex	64	60

NERVES REPAIRED

PNAP

Median	5
Ulnar	4
Digital	4
Common Digital	2
AIN	2
PIN	1

Mean Gap
41 ± 21 mm
(9 - 80 mm)

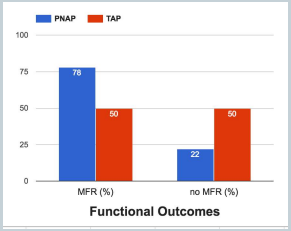


TNAP

Median	2
Ulnar	2
Digital	15
Common Digital	2
DCBUN	1

Mean Gap
26 ± 14 mm
(15 - 50mm)

RESULTS

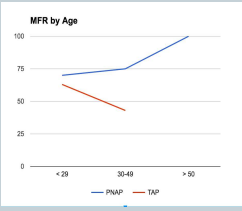


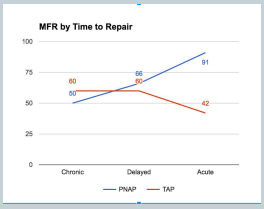
	MFR	No MFR	Totals
PNAP	14	4	18
TAP	11	11	22
Totals	25	15	40

Pearson's Chi-square test $p = 0.0710$

Fisher's exact test $p = 0.0688$

SUBGROUPS





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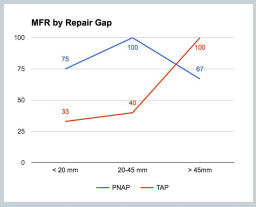

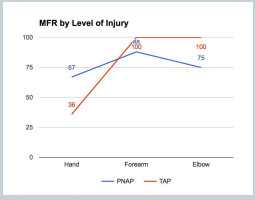

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REFERENCES

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