INTRODUCTION

• Research with sheep aiming to alleviate human neck and back pain.

A leading cause of activity limitations in the United States is neck and back pain. Conservative treatment is the first line of therapy before surgical intervention. However, patient conditions progress to a single surgical option, spinal fusion. Cervical and lumbar regions of the spine are the most common areas that receive correction. A wide array of instrumentation and biologics are available to promote bony fusion of vertebrae. Research with sheep has allowed for these advances in orthopedics with the goal to minimize spinal pain.

CLINICAL RELEVANCE

Sheep are a proven model for human spinal fusion:

• Convenient for research
• Can use many sheep for research
• Inexpensive
• To obtain
• Maintenance

Biomechanically equivalent

• Range of Motion
• Bone Size
• Equivalent instrumentation

SPINAL FUSION OSTEOSTRICTIVE MATERIAL

AUTOGRAFT versus BMP

• Many spinal fusion devices utilize biologics to promote bone fusion
• Autograft and Bone-Morphogenic Protein most widely used

Autograft:

• Acquired from bone marrow
• Spinal fusion limited by amount
• Additional surgical site for collection

Bone-Morphogenic Protein (BMPs):

• Growth factors
• Scant amount for spine fusion
• High fusion rate in lumbar spine
• No surgery for collection

Fusion more stiff with BMP than Autograft

LUMBAR SPINE FUSION

• Lumbar spinal fusion is used to treat the following:
  • Degenerative disc disease, trauma, deformity, tumors
  • Challenging to obtain a solid fusion of vertebrae
  • Mechanical & biological variables research in sheep

VENTRAL LUMBAR INTERBODY FUSION

• Avoids surgical injury to dorsal (posterior) structures
• Easy to access disc space & realign vertebrae
• Interbody cages a current area of research

THREADED INTERBODY FUSION CAGES

• Placed at center of vertebral rotation and weight-bearing axis
• Packed with autograft of BMP on collagen sponge
• Opens permits content to have direct contact with bone
• Bone formation encouraged by constant compression between bone and implant

INSTRUMENTATION

• Pedicle screw instrumentation replaced by interbody fusion cages.
• Titanium and PEER cages available

Polyetheretherketone (PEER)

• Advantages over titanium cages:
  • Radiolucent to evaluate fusion
  • Not as rigid and no artifact
  • Only moderate inflammation

DORSAL LUMBAR INTERBODY FUSION

• Utilizes vertebral processes and pedicles
• Instrumented or Un-instrumented dorsal fusion
• Autograft or BMP on collagen sponge can be used
• Disc space access is difficult by this approach

UN-INSTRUMENTED

• Bioabsorbable scaffolding
• Spans two transverse processes
• Contains calcium and phosphorus to stimulate BMP
• Held in place by suture and surrounding muscle

INTERVERTEBRAL LUMBAR FUSION

• Decompression for lumbar stenosis
• Wedged between spinous processes
• Device fuses adjacent processes
• Reduces:
  • Pathologic extension
  • Intradiscal pressure
  • Facet loading
• Allows unrestricted:
  • Axial rotation
  • Flexion
• Prevents narrowing of spinal canal

CERVICAL SPINE FUSION

• Cervical trauma and disc disease treated by surgical fusion
• Most often involved
  • Cervical spine C3-C7

VENTRAL CERVICAL INTERBODY FUSION

• Cervical versus lumbar spine
  • Greater range of motion
  • Different biomechanical forces
  • Harder to fuse

• Titanium plating current cervical fusion method

• New pursuits with a sheep model to advance cervical fusion
  • PEER implant with containment plate
  • Goal to prevent implant extrusion and migration
  • Test soft tissue reaction to BMPs

• These sheep under short-term evaluation for:
  • Single-level fusion
  • Dysphonia
  • Dysphasia
  • Laryngeal nerve neuritis
  • Swelling of neck

OTHER HUMAN RESEARCH WITH SHEEP

• Human medical treatments continue to advance by sheep model application

• Sheep ideal for many orthopedic studies:
  • Vertebraplasty
  • Vertebral body reconstruction
  • Dynamic Stabilization
  • Laminitos
  • Epidual Fibrosis
  • Barrier implants
  • Rotator cuff tendon injuries

• New studies intending to use sheep:
  • Cervical fusion
  • Anterior cruciate ligament replacement

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