Freeze-Dried Fibular Allograft in Anterior Spinal Surgery: Cervical and Lumbar Applications

F. Todd Wetzel, M.D., Michael A. Hoffman, B.S., and ROCCO R. Arcieri, B.A.

The Pennsylvania State University, College of Medicine
The Milton S. Hershey Medical Center, Hershey, Pennsylvania

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Fifty-six patients who underwent anterior fusion utilizing fibular allograft are reviewed. Thirty-two patients underwent multiple-level anterior cervical discectomy and fusion utilizing fibular strut allograft, and 24 underwent anterior lumbar discectomy and fusion using fibular strut allograft. Cervical surgery was performed via the strut technique of Whitecloud and LaRocca [41] and lumbar surgery was performed via a transperitoneal or retroperitoneal approach.

Postoperatively, patients were assigned a clinical grade based on symptomatic relief and medication usage. X-rays were visually inspected, and quantitatively digitized for Cobb angle and translation in order to assess the status of arthrodesis.

In the cervical group, the rate of clinical success (87.5%) exceeded the arthrodesis rate. By inspection, 65% fused, at a mean time of 23.5 months postoperatively. In the lumbar group, the overall clinical success rate was 68%. This correlated quite strongly with a fusion rate of 58%. Smoking was a negative correlate with arthrodesis. Patients receiving Workers' Compensation were also more likely to have an unsatisfactory clinical outcome.

The results of this study highlight the difference between anterior arthrodesis in the cervical and lumbar spine. The biomechanical stability afforded by the fibular strut in the cervical spine appears to outweigh the disadvantages of delayed time to union. The rate of posterior cervical fusion to salvage symptomatic pseudoarthrosis was quite low (9.3%), thus suggesting that additional posterior surgery in this particular group of patients should not be considered for a minimum of two years postoperatively. In the lumbar group, status of arthrodesis correlated closely with clinical outcome. Fusion rate in this group was disappointing, corresponding to other reports in the literature. Based on these data, primary anterior body fusion without allograft in the lumbar spine cannot be recommended, as a viable alternative to conventional autograft.

INTRODUCTION

Anterior interbody arthrodesis using autogenous iliac crest graft is widely accepted, [5, 11–14, 22, 27, 29, 36] and results in a high rate of union. In the cervical spine, this consists of anterior cervical discectomy, followed by insertion of a rectangular tricortical iliac crest graft into the intervertebral space. The effects of this are two-fold: height of the intervertebral segment and, thus, of the neuroforamina, is preserved by maintenance of disc space height, and stability is preserved as the interbody arthrodesis matures. The harvesting of the autogenous graft from the iliac crest, however, is not a benign procedure. Many authors have noted complications arising from both anterior and posterior harvest [3, 5, 8, 10, 15, 18, 20, 21, 24, 28, 30, 32, 36, 37]. A separate skin incision is required for graft harvest. Anteriorly, this takes the form of a curvilinear incision superior to the iliac

*To whom correspondence should be addressed. Tel. (312) 878-8700 ext. 1822; FAX: (312) 728-5407.
wing, extending not anterior to the anterior superior iliac spine. Posteriorly, again, the curve of the iliac wing is followed, with the posterior superior iliac spine limiting the posterior extent. Complications from anterior harvest include pain [3, 5], injury to the lateral femoral cutaneous nerve [20, 24, 37], resulting in meralgia paresthetica, cosmetic defects [21], hematoma formation [5, 30, 37], infection [21], and herniation of abdominal contents [21]. Complications from posterior graft harvest include sensory changes [33, 38], superior gluteal arteriovenous fistulae [8], urethral injury [8], sacro-iliac joint injury, superior gluteal artery perforation [18], peritoneal perforation [18], gluteal weakness [1]. As most grafts for anterior surgery are harvested from the anterior approach, the former set of complications are more germane to surgery performed in that matter.

The use of allograft obviates these difficulties. Allograft has been utilized in anterior spinal surgery with varying reports of success [7, 9, 23, 45]. Fielding, in reviewing cervical interbody fusion, noted that allografts and autografts may be employed [11]. Schneider and Bright [31] reported good results in anterior cervical fusion employing allografts. Dryer and LaRoca [7] reported a very high rate of fusion (51 of 53 cases) using fibular strut allograft in multiple-level cervical procedures. Allograft is also advantageous due to the immediate rigidity afforded by the tubular cortical graft [7, 41]. The rigidity was quantified by Wittenberg et al. [43] in *in vitro* biomechanical testing. All grafts were obtained from human cadavers and frozen at −20°C. Anteriorly-placed fibular strut allografts were found to be significantly stronger than anterior iliac crest grafts or rib grafts [43]. Biologically, allograft also appears to be a viable clinical alternative. Yamaguchi et al. [44], in a dog model, demonstrated new bone formation within 4 weeks of allograft posterior spinal fusion; bony union was completed at 8 weeks, and creeping substitution had replaced the lamina by 32 weeks. Clinically, the use of allografts has become increasingly widespread. Miller et al. [26], in a survey of current practice, reported that 55% of spinal surgeons employed bone allograft, most commonly for benign bone tumor defects or spinal fusion. A high rate of fusion (100%) was reported by McCarthy et al. [25] in a series of 32 patients with surgery performed for paralytic scoliosis.

In the cervical spine, high rates of success have been reported with single-level interbody fusion using conventional Smith-Robinson techniques with autograft: in the authors' initial report, for example, 18 of 22 levels fused solidly [34]. In this technique, a transverse skin incision is made at approximately the level of C6 (two to three finger-breadths above the clavicle). The platysma is divided and the sternocleidomastoid exposed. The carotid sheath is identified; by keeping the sheath laterally, a plane is afforded to the prevertebral space [34, 35]. After appropriate lateral roentgenographic localization, anterior discectomies are performed. If more than one discectomy and fusion is to be performed, multiple levels are accessible by this technique (from C2-3 to C7-T1). However, with multiple-level fusions, higher nonunion rates occur [16, 40, 42]. In an effort to improve on the biomechanics of multiple level interbody fusions, a fibular strut has been proposed [41]. In this technique, the tubular fibula is anchored at the cranial and caudal levels desired; a trough is cut in the intervening vertebral bodies for secure purchase. Initial reports of autograft fibula procedures noted high fusion rates, but it became evident that incorporation may require greater than two years for radiographic confirmation [9]. Additionally, a 19% rate of donor-site morbidity (i.e., the fibular harvest) was reported [41]. In a long-term study of 126 patients, Femyhough et al. [9] compared fusion rates in patients undergoing multiple-level anterior cervical fusion using fibular allograft and autograft. They reported a high nonunion rate in both groups: 27% in the autograft group and 41% in the allograft group. A minimum follow-up of 24 months was required for inclusion in this study. While the authors used rigorous radiographic criteria, additional variables known to influence fusion rate, such as smoking [47], were not studied.
Zdeblick and Ducker [45] compared freeze-dried allograft and tricortical iliac crest autograft in 87 patients undergoing Smith-Robinson anterior cervical fusion. In patients who required multiple-level procedures, serial Smith-Robinson procedures, i.e., anterior interbody grafts at multiple, contiguous levels, rather than a strut, were used. At a follow-up of one year, a delayed union rate of 7% for autograft and 21% for allograft in one-level procedures was noted. For two-level procedures, the non-union rate was 17% for autograft and 63% for allograft. Graft collapse was seen more commonly with allograft, but relief of symptoms, namely neck and arm pain, was similar in both groups [45].

Anterior discectomy and interbody fusion in the lumbar spine may be performed via a retroperitoneal (flank) approach or transperitoneal (anterior) approach. The retroperitoneal approach affords access to upper lumbar discs; occasionally the lumbosacral junction is difficult to expose due to the iliac vessels. The anterior, transperitoneal approach affords access to L₂-S₁ or L₄-L₅; more cranial levels are obscured by the iliac bifurcation. For both approaches, surgical techniques are similar: thorough discectomy followed by reconstitution of the disc space with auto or allograft. VanRens and VanHorn [39] reported a fusion rate of 96% in patients undergoing anterior lumbar interbody fusion using autograft. Freebody et al. [13], in describing the results of anterior transperitoneal lumbar fusion using autograft, reported an 84% fusion rate. Leong et al. [22] reviewed the long-term results of anterior lumbar fusion for disc prolapse, noting clinical improvement in 67.5% at 5 years. The fusion rate varied according to length of fusion: 83% of patients who underwent a single-level fusion were felt to have a bony union, whereas 57% of patients fused at two levels were felt to have healed. In anterior lumbar fusion using different varieties of autografts, Stauffer and Coventry [36] noted a fusion rate of 56% at a minimum of 18 months post-operatively, with an overall clinical success rate of 36%. The authors felt that the "correlation of clinical and radiographic results was not absolute." Flynn and Hoque [12] reviewed 50 patients who underwent anterior fusion with autogenous graft and noted a similar union rate, 56% (follow-up from 2 to 15 years). They noted that patients with iliac crest grafts healed an average of 2.5 years and those with fibular grafts, 5.2 years. The clinical success rate of 52% did not correlate strictly with the results of a solid arthrodesis.

Thus, any choice of grafting material for anterior spinal surgery must take several factors into account. These include both biomechanical and biological considerations, as well as consideration of graft site morbidity. Clearly, the use of allograft obviates the latter. Additionally, the immediate biomechanical stability afforded by allograft is superior to that afforded by autograft. However, reports of erratic union rates are of concern. Additionally, no firm correlation between clinical outcome and fusion rate has been demonstrated. Overall, it would appear that in terms of union rate, the use of allograft is disadvantageous. A more pertinent concern is, however, the clinical significance of this apparently diminished rate of union. Based on review of the literature, this is unclear.

It is the purpose of this study to examine two distinct patient populations who underwent either cervical or lumbar interbody fusions utilizing fibular allograft to determine union rate and to correlate this with clinical outcome. These data will be compared to historical controls as outlined in the above studies. A pertinent analysis of potentially confounding patient variables will also be included.

**MATERIALS AND METHODS**

A total of 56 patients were included in this study. Thirty-two underwent anterior cervical discectomy and fusion utilizing fibular strut allograft, and 24 underwent anterior lumbar discectomy and fusion utilizing fibular strut allograft. The freeze-dried, nonde-mineralized fibulae were all obtained from a single source (University of Miami Bone...
Bank). All allografts were stored in sealed vacuum containers at room temperature until use. All patients had complaints of axial pain and/or radicular symptoms, and all patients had failed conservative treatment. Surgery was performed in a standard manner by the senior author. In the cervical group, all surgery was performed via an anterior approach [35], with grafting according to the technique of Whitecloud and LaRocca [41]. In the lumbar spine, surgery was performed via a transperitoneal approach for L4-S and L5-S, or via an extraperitoneal approach for more cranial segments. Discs were removed in toto, and disc spaces were packed with fibular allograft. Post-operatively, patients in the cervical group were supported with a hard cervical collar for three months. In the lumbar group, a chairback brace was used for three months post-operatively; in those patients whose fusions included the lumbosacral interspace, a thigh cuff was added.

A comprehensive questionnaire was utilized for data collection (Table 1). Details of patients' demographic data, diagnostic evaluation, and follow-up were gathered. A database was constructed in order to analyze all discrete and continuous variables for effect on fusion rate and clinical outcome. Clinical outcome was determined using a
standardized scale as follows: excellent outcome - minimal symptoms, no use of analgesics; good outcome - marked improvement over preoperative symptoms, rare use of analgesics; fair outcome - some improvement over preoperative status, continued need for analgesics, significant functional limitations; poor outcome - no improvement from preoperative status or functional capacity, regular analgesic use. In cases where analgesic usage or functional status differed categorically from pain relief, the outcome was assigned to the more extreme (worse) category [46]. For the purposes of data analysis, a good or excellent outcome was taken to connote a satisfactory outcome, whereas a fair or poor outcome was taken to connote an unsatisfactory result. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS, Chicago, Illinois). For comparison of two continuous variables (e.g., age, injury date) Pearson's coefficient was used. Standard two-tailed $t$-tests were used to determine difference between means, point - by serial techniques to correlate categorical with continuous variables, chi - square to compare categorical ratings, and multivariate analysis to compare multiple dependent variables. The role of the latter was extremely limited as many continuous variables were collapsed into contiguous variables to address the central goals of the study (i.e., fusion rate and clinical outcome). For example, in assessing fusion, sagittal change was assessed...
by digitization on serial roentgenographs. If less than 3 mm of change had occurred, this
was taken to represent fusion (FUSION - Y/N - see Table 1).

The status of the fusion was evaluated in two ways. If mature trabecular lines crossed
all levels fused on plain x-rays, the fusion was graded as solid according to visual inspec-
tion. Additionally, x-rays were digitized and the amount of angular change (Cobb angle)
and translational change between the cranial and caudal bodies included in the fusion
were quantified. Fusion was felt to have occurred if, on serially digitized films, the Cobb
angle changed less than 4°, and translation was less than 3 mm [4]. As a check on accura-
cy of digitization, each investigator serially digitized the same x-ray three times. Standard
error for the Cobb angle was 4°, and standard error for the translational measure was 3
mm. Flexion-extension views, as well as static films were measured. The
Roentgenographs were taken pre-operatively, immediately post-operatively, and at three
months, six months, one year, and yearly thereafter to maximum follow-up or until fusion
occurred.

Statistical analysis was conducted, according to conditions imposed by data charac-
teristics. The pertinent questions considered during data analysis were the impact of
potentially confounding demographic variables (e.g., Workers' Compensation, cigarette
smoking) on clinical outcome and fusion rate, the relationship of fusion rate to clinical
outcome and the need for re-operation to accomplish fusion.

RESULTS

CERVICAL GROUP

The average age in the 32 patients who underwent anterior cervical discectomy and
fusion was 49 years (32–78 years). There were 14 males and 18 females in the group. In
29 of the patients, the etiology was degenerative. One patient underwent reconstructive
surgery for post-decompression instability, one for fracture, and one for tumor. Five
patients had undergone prior anterior cervical discectomy and fusion. Of these 5 patients,
3 underwent a single anterior cervical discectomy and fusion with iliac crest autograft,
and 2 underwent multilevel fusions with autograft.

Six patients were laborers. Twenty-eight patients were engaged in either sedentary
occupations or were retired. Six patients were receiving Workers' Compensation at the
time of surgery, and eight patients attributed their symptoms to a work-related injury. In
seven patients, litigation was pending. Ten patients were cigarette smokers.

The most common level fused was C5-6 (26 patients). Twenty patients underwent
two-level fusions, 8 patients underwent three-level fusions, 3 patients underwent four-
level fusions, and 1 patient underwent a six-level fusion. Mean follow-up in the cervical
group was 19 months (8 months–3 years, 5 months). Two patients died during follow-up.
One patient, suffering from metastatic disease related to a primary lung tumor, died of
nonspinal neoplastic complications 8 months post-operatively. The other patient, an
elderly female, died of unrelated causes, 13 months post-operatively.

Radiographic results

By inspection of plain films, 21 patients, representing 65% of the total, were judged
to be fused. Mean time to fusion was 23.5 months post-operatively (14 months–3 years, 2
months). An example of a patient who was judged to have fused is shown in Figure 1. By
quantitative criteria, 26 patients (81%) were judged to be fused by serial measurements of
the Cobb angle. The mean time to fusion by these criteria was 9.9 months post-operative-
ly (5 months–2 years, 6 months). By digitized translational criteria, 25 patients (78%) were
judged to have fused at a mean of 9 months post-operatively (6 months–3 years).
Clinical outcome

Twenty-eight of 32 patients (87.5%) were judged to have had a satisfactory clinical outcome. This occurred at a mean of 15.4 weeks post-operatively (1.8 weeks–5.5 months post-operatively).

Complications

Two patients experienced graft dislodgement. One patient experienced posterior dislodgement of the caudal receptor site at 12 weeks post-operatively. A second patient experienced cranial dislodgement of a three-level fusion at 3 months post-operatively. Both patients required operative revision. The posterior re-operation rate - posterior cervical fusion to treat delayed or nonunion - was 9.3% (3 patients). There were no post-operative infections.

Of all the demographic variables, only the presence of Workers' Compensation was found to correlate with outcome. This was a negative correlate ($p < 0.05$, chi-square). Smoking did not correlate with outcome. Fusion status, likewise, did not correlate with clinical outcome in a statistically significant manner.

LUMBAR GROUP

The mean age of the patients undergoing anterior lumbar surgery was 46 years (24–74 years). There were 11 males and 13 females in this group. Four patients reported a work-related injury. There were 16 laborers in the group, and 8 sedentary or retired persons. Fourteen patients smoked cigarettes, and 10 patients were receiving Workers' Compensation.

One patient suffered a fracture. In one patient, the indications for surgery was thoracolumbar kyphosis. The remainder all suffered from symptomatic degenerative disease. Nineteen patients underwent prior posterior lumbar surgery. No patient had undergone prior anterior lumbar surgery.

Twelve patients underwent two-level fusions, nine patients underwent a single-level fusion, two patients a three-level fusion and one patient a four-level fusion. The most commonly fused interspaces were L4-5 and L5-S1. Mean follow-up for this group was 2 years (18 months–5 years, 1 month).

Radiographic results

By inspection, 14 patients (58%) were judged to have fused at a mean of 2 years, 3 months post-operatively (1 year, 1 month–5 years). By digitization translational parameters, fusion occurred at a mean of 1 year, 4 months post-operatively (7 months–4 years post-operatively); Cobb criteria fusion occurred at a mean of 1 year, 5 months post-operatively (5 months–4 years, 3 months).

Clinical outcome

A satisfactory clinical result was obtained in 14 patients, representing 58% of the total. Patients who obtained a satisfactory clinical outcome did so at a mean of 5 months post-operatively (6 weeks–2 years post-operatively).

Solid arthrodesis, as determined by Cobb criteria, was found to correlate positively with a satisfactory clinical outcome ($p = 0.02$ chi-square). Smoking was a negative correlate with arthrodesis, as measured by both digitization techniques ($p = 0.012$, Chi-Square, translation; and $p = 0.005$ chi-square, Cobb). Patients receiving Workers' Compensation were more likely to have an unsatisfactory clinical outcome ($p = 0.009$, chi-square).
Complications

Two patients suffered from a post-operative wound infection, and one patient experienced retrograde ejaculation post-operatively.

DISCUSSION

The fusion rates reported in this study for anterior cervical and lumbar procedures are comparable to those reported elsewhere in the literature [9, 10, 12, 13, 14, 20, 22, 30, 36, 41, 45]. It would appear, however, that in terms of clinical outcome, the status of the arthrodesis is more critical in the lumbar spine. In the cervical spine, the rate of clinical success exceeded that of radiographic union. Hence, in multilevel cervical fusions, the intrinsic biomechanical stability of the Whitecloud-LaRocca technique seems to outweigh any advantages of early union using autograft. Additionally, the rate of salvage surgery - posterior cervical fusion - was much lower than reported in other studies [9]. Given the length of time required for allograft incorporation and the observation that clinical success occurred at a much earlier time than radiographic union, the use of posterior fusion to secure arthrodesis can be recommended only with caution. Based on these data, it would appear that posterior cervical fusion should not be considered before two years post-operatively.

In the lumbar spine, only 2 of 5 primary anterior interbody fusions healed. This represents no improvement in fusion rates from fusions performed with autograft. The additional biomechanical stability provided by the fibular allograft appears to have limited clinical utility. No benefit was accrued by patients until fusions were solid.

In the cervical spine, fusion status did not correlate with smoking; in the lumbar spine, it did. This finding is in agreement with other studies of lumbar fusion [2] and tends to highlight the "forgiving" nature of cervical surgery. In both groups, reliance on Workers' Compensation predisposed to a poor clinical outcome, again corroborating other studies [6, 17, 19].

In the cervical spine, the predominant clinical concern in multilevel anterior arthrodesis is stability. Biological union occurred late. This did not, in any way, influence a successful clinical outcome. While it has been reported that "completion of the tension band" by posterior cervical fusion secures union [9], based on these data, the clinical significance of this is quire unclear. Hence, no recommendations for subsequent posterior surgery, based solely on radiographs, can be made.

Anterior interbody arthrodesis in the lumbar spine continues to be problematic. Based on these results, primary anterior interbody fusion with fibular allograft cannot be recommended as a superior alternative to autograft. The rate of union is low, and clinical results are disappointing. Based on a critical review of series performed with autograft [12, 22, 36], it is difficult to conclude that either technique is superior: while the fusion rate with autograft may be higher, the disadvantages of donor site morbidity remain. Likewise, the role of allograft in so-called "360 fusions" (i.e., anterior and posterior) remains unclear. With more widespread application of rigid anterior and posterior fixation, the utility of this may become more evident.

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Table 1. Questionnaire used to gather demographic, pre-operative, and follow-up data.
Fibular Allograft in Anterior Spinal Fusions

1. Demographic data

| Name:          | Hospital #: |
|---------------|-------------|
| St. Address:  | Study #:    |
| City/State/Zip: | Sex: M/F    |
| Phone (H):    | Race: BL/WH/AS |
| Phone (W):    | Weight:     |
|DOB (Mo/Da/Yr) | Preg #:     |
| Date of Last Preg. (Mo/Da/Yr) | Marital Status: M/W/D/S |
| Smoker: Y/N  | ETOH: Y/N   |
| If yes, amount (in pack years) | Injury Date (Mo/Da/Yr) |
| Injury: Y/N  | Injury location (work, home, etc.) |
| Injury location | Injury action (bend, twist, etc.) |
| Workers' Comp. Status: | Working at time of referral: Y/N |
| Working at time of referral | Work Type: H Manual/L Manual/Office/FT Driver |
| Deformity: Kyphosis/Scoliosis/Spondylolisthesis | Deformity Level: |
| Deformity Level | Spasm: Y/N |
| Previous Surgery | Levels |
| Discectomy | Approach |
| Laminectomy | instr |
| Corpectomy | Dr |
| Anhrodesis | Compl. |
| OTC medications | RX medications |

2. Signs and Symptoms at Referral

| Date of Referral (Mo/Da/Yr) | SX Onset (Mo/Da/Yr) |
|-----------------------------|---------------------|
| Disability Stat:            | Lit. Stat:           |
| Pain                        |                     |
| Chief Complaint (w/ location) |                   |
| Axial                      |                     |
| Appendicular                |                     |

Physical Findings

Axial tenderness:

| Sensory: | Unilateral |
|----------|------------|
| Dermatoma | NonDermatoma |
| Bilateral | Dermatoma |
| Nondermatoma | Nondema |

Motor: Unilateral

Distal Motor Intact? Y/N

Trendelenburg Sign: Pos/Neg

Neurogenic bladder: Pos/Neg

Straight Leg Raise (Active): Pos/Neg

Straight Leg Raise (Passive): Pos/Neg

Posture Stat: |

Heel/Toe Walk Stat:

Limb Length Stat:

Root Tension Signs (Lasaque): Unilateral Bilateral

Root Tension Signs Level(s):

DTR: 0 1+ 2+ 3+ 4+

Deep Tendon Reflexes Symmetrical? Y/N

Range-of-Motion:

Flexion: Extension:

Limited by:
3. Pre-operative Evaluation.

| DX Type: | Tumor | Trauma | Infection | Degenerative |
|----------|-------|--------|-----------|--------------|
| DX Level(s): | Test | Status (Y/N) | Findings | Levels |
| XR: | | | Disc Collapse | |
| | | | Osteophytes | |
| | | | Spondylolisthesis | |
| | | | Segmental Instability | |
| | | | Fused | |
| | | | Normal | |
| MRI: | | | Disc Degeneration | |
| | | | Stenosis | |
| | | | Normal | |
| CT: | | | Disc Degeneration | |
| | | | Fracture | |
| | | | Normal | |
| Myelogram (CT): | | | Disc Prolapse | |
| | | | Disc Hemiation | |
| | | | Stenosis | |
| | | | Normal | |
| Discography (CT): | | | Morph Normal | |
| | | | Morph Abnorm | |
| | | | PN Repro Concordant | |
| | | | PN Repro Discordant | |
| Facet Block: | | | Root Sheath: | |
| Root Sheath: | | | | |
| EMG/NCV: | | | | |
| DX/RX Bracing: | | | | |

4. Primary Surgery Information.

Date of Surgery (Mo/Da/Yr): __________
TX Prior to Surgery:

| Dr. | Type | Level(s) | Approach | Instr. |
|-----|------|----------|----------|-------|
|     | Discetomy | | | |
|     | Laminectomy | | | |
|     | Arthrodesis | | | |
|     | Corpectomy | | | |

Blood Loss:
Discharge Date (Mo/Da/Yr): __________
Discharge DX:
Bracing: Y/N
5. Follow-up.

Follow-up #: [Blank]
Complications: Y/N

Follow-up date (Mo/Da/Yr): [Blank]
If yes, rel to spine surg? Y/N

Chief Complaint (w/location)
Axial
Appendicular

Action(s) taken:

| Pain         | Excellent | No Pain | Satisfactory |
|--------------|-----------|---------|--------------|
|              | Good      | Marked Relief |             |
|              | Fair      | Moderate Relief | Unsatisfactory |
|              | Poor      | No Relief/Worse |             |

| Sensory      | Improved | Not Improved |
|--------------|----------|--------------|
| Motor        | Improved | Not Improved |

Neurogenic Bladder: Y/N

OTC Medications:

| Narcotic Usage | Excellent | None | Satisfactory |
|----------------|-----------|------|--------------|
|                | Good      | Occasional |             |
|                | Fair      | Regular | Unsatisfactory |
|                | Poor      | Daily |              |

Braced: Y/N

Physical Therapy Y/N

XR Fusion Solid: Y/N

XR Graft: Satisfactory

XR Hardware in place: Y/N

XR Medcations:

| RX Medcations | Satisfactory | I | Unsatisfactory |
|---------------|--------------|---|----------------|

Retumed to work: Y/N

Disability: Y/N

Litigation: Y/N

Overall Rating (Clinical):

| Excellent | Satisfactory |
|-----------|--------------|
| Good      |              |
| Fair      | Unsatisfactory |
| Poor      |              |