

## POSTERIOR SURGICAL TREATMENT FOR THE RHEUMATOID CERVICAL SPINE

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### SUMMARY

Twenty-six patients with rheumatoid disease affecting the cervical spine underwent surgical treatment for neck pain, neurological deficit, or both. Atlantoaxial subluxation ( $n = 13$ ), subaxial subluxation ( $n = 7$ ) and vertical migration of the odontoid ( $n = 6$ ) were treated. Arthrodesis with autologous bone was augmented with wire, Ransford loop, Hartshill rectangle or Magerl technique. Pain relief occurred in 92% of patients. Neurological deficit improved in 89% and was unchanged in the remainder. Radiographic stability was achieved in all but one patient. Posterior surgery effectively relieved pain and neurological deficit, and the complications encountered did not jeopardize the outcome.

**KEY WORDS:** Cervical spine, Rheumatoid disease, Posterior, Surgery, Fusion.

THE rheumatoid cervical spine develops deformity secondary to joint damage when ligament laxity, cartilage and bone destruction, and regional osteoporosis occur. These features often reflect multiple joint involvement with erosive arthropathy, yet cervical instability can occur early in the course of the disease [1]. Pathological odontoid fracture and pannus formation can further contribute to instability and cord compression. Neurological change may range from occipital neuralgia to severe quadriplegia and death [2, 3]. On occasions, the general debilitation and disability associated with rheumatoid arthritis may mask the presence of significant rheumatoid myelopathy, and therefore a high index of suspicion is necessary.

Detailed neurological evaluation systems useful in cervical spondylitic myelopathy cannot be used in rheumatoid arthritis because of multi-system involvement. As a result, less specific classification systems are used [4].

We describe a series of patients undergoing posterior cervical fusion for destructive changes secondary to rheumatoid arthritis. The results of surgery based on symptomatic improvement incorporating a modified neurological grading system are described.

### PATIENTS AND METHODS

A retrospective analysis of 26 patients with rheumatoid disease requiring posterior surgical stabilization of the cervical spine was made over a 10 yr period. Twenty-one females (mean age 62 yr, range 32–82 yr) and five males (mean age 75 yr, range 66–88 yr) presented with either neck pain ( $n = 12$ ), neurological deficit ( $n = 1$ ), or both ( $n = 13$ ).

At the time of surgery, all patients presented with disease of at least 8 yr duration associated with multiple joint involvement. The duration of follow-up was 24–78 months as assessed at the time of their last clinical follow-up.

Plain radiographs were interpreted both pre-

operatively and post-operatively, and the presence of atlantoaxial subluxation (AAS), subaxial subluxation (SAS) or vertical migration of the odontoid (VMO) was recorded.

Neurological assessment incorporated a modification of the Ranawat grading (Table I). This modification distinguished asymptomatic hyper-reflexia from sensory symptomatology into Grade 1 and 2, respectively. These findings had been combined in one grade in the original Ranawat scale [5]. This enabled establishment of relative improvement when a patient noted resolution of sensory symptoms yet remained hyper-reflexic.

Pain assessment was removed in our Modified Ranawat Scale since pain and neurological deficit are not necessarily related in magnitude. For the purposes of this study, pain considered to be arising from the cervical spine was subjectively assessed by the patient and graded as nil, mild, moderate or severe.

These features were recorded at the initial consultation and repeated at the time of follow-up examination.

### RESULTS

AAS was observed in 13 patients (11 females and two males) of mean age 64 yr (range 48–82 yr) at the time of the study. The deformity predominantly resulted from progressive destructive change ( $n = 11$ ), but was directly related to trauma in two patients. Destructive change with odontoid erosion was present in the majority and a fracture of the odontoid peg was seen in four patients. The mean anterior dens interval was 12 mm (range 8–20 mm). The mean posterior dens interval was also 12 mm (range 5–23 mm).

SAS was detected in seven patients (five females and two males) of mean age 66 yr (range 46–74 yr). Subluxation at a single level occurred in three patients and at two or more levels in the remainder (predominantly at C2/3 and C4/5). The mean space available for cord (SAC) was 12 mm (range 8–15 mm).

VMO was stabilized in six patients (five females and one male) of mean age 65 yr (range 32–88 yr). It was associated with craniocervical pain, facial pain, cranial nerve dysfunction or difficulty in swallowing in the majority.

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TABLE I

The Modified Ranawat score used in this study compared to the traditional score

Ranawat score	
Grade 1	Pain, no neurological deficit
Grade 2	Subjective weakness, hyper-reflexia, dysaesthesia
Grade 3a	Objective weakness, long-tract signs, ambulatory
Grade 3b	Objective weakness, long-tract signs, non-ambulatory
Modified Ranawat score	
Grade 0	No neurological abnormality
Grade 1	Hyper-reflexia, asymptomatic
Grade 2	Sensory alteration
Grade 3	Motor weakness, ambulatory
Grade 4	Motor weakness, non-ambulatory

A combination of AAS and SAS was noted in four patients, although only one deformity was considered to be the source of symptoms.

#### *Surgical procedures*

Pre-operative traction was used in only two patients with AAI presenting after a definite history of trauma. Awake fibre-optic intubation with subsequent neurological examination was preferred, although standard intubation and induction of anaesthesia was deemed safe in five patients. Skull tongs were applied and patients were positioned either using a Stryker frame or turned manually. Intra-operative traction was applied.

A routine posterior exposure to the appropriate level for fusion was made and the site confirmed using a lateral radiograph.

Fusion was performed with bone graft harvested from the iliac crest alone (1), or augmented with either wires (7), Ransford loops (3) or Magerl screws (2). Laminectomy of the atlas was performed in two cases for marked stenosis and cord compression, and this laminectomy required extension of the fusion beyond the decompressed area. Sublaminar wires were avoided at C1 if the AAS could not be reduced and the fixed subluxation had been accepted at surgery. Post-operatively, tongs were removed, and the neck immobilized in a collar or brace for up to 3 months.

The assessment of discrete neck pain in this group of patients was difficult. All patients noted improvement in neck pain of at least one grade. Pain relief (recorded as nil or mild) was achieved in 24 patients (92%). The remainder recorded no change. Worsening of pain was not observed. Furthermore, patients with AAI and VMO reported relief from severe upper cervical spine pain, occipital neuralgia and headache.

Neurological deficit, where present, was improved by one grade or more in 23 patients (89%). Although no change was observed in the remaining three patients, pain relief did occur. Deterioration in neurological status was also not observed (Table II).

Radiographic stability (as defined by maintenance of reduction and implant position during follow-up) was achieved in all but one patient. In the latter case, AAS recurred, although the patient reported significant pain relief. Resorption of bone graft was seen in three patients. In the remainder, there was good evidence of

TABLE II

The pre-operative and post-operative neurological grades. The greater the grade reduction, the larger the clinical improvement

Post-operative grade	Pre-operative Modified Ranawat grading				
	0	1	2	3	4
0	7		2	1	1
1			8	3	2
2			1		
3				1	
4					

posterior radiographic fusion. A stable fusion was also achieved in those patients presenting with odontoid fracture.

Two patients died (25 months and 36 months, respectively) after surgery from unrelated causes and two patients were lost to follow-up. Their outcomes were assessed from the last clinical entry from the notes.

#### *Complications*

Fibre-optic intubation was not technically possible in one case and tracheostomy was performed. In a further case, the endotracheal tube became dislodged upon turning and re-insertion was required. One patient developed a post-operative superficial wound infection which resolved with oral antibiotics. Fusion at an incorrect level was performed on one occasion, and this required re-operation. This occurred despite intra-operative radiographs, the interpretation of which was complicated by spontaneous fusion at several levels.

Technical difficulties included marked haemorrhage in three cases, in one case possibly due to vertebral artery damage using a Magerl C1/C2 screw fixation technique. Pull-out of sublaminar or occipital wires on tightening occurred in two cases, although construct stability was not jeopardized. SAS was detected in two patients 6 and 8 yr, respectively, after C1/C2 fusion. Neither case has required further surgical intervention.

One patient fell 8 months after initial successful cervical stabilization for severe SAS. He dislocated a recent total hip replacement and developed significant myelopathy after the fall. Although CT myelography did not show evidence of cord compression, this late deterioration may represent cord injury without spinal column injury.

## DISCUSSION

Neurological change may occur in 2.5% of patients with rheumatoid involvement of the cervical spine and, when present, denotes a poor prognosis [6]. The results from our study indicate that posterior stabilization of the cervical spine provides effective relief of neck pain with associated neurological improvement. These findings are consistent with previous reports with regard to pain relief [7, 8], although the number of patients showing improvement in neurological deficit (89%) was greater in our series [9]. The reasons for this

marked difference are not clear, but may represent the modification of the grading system we have used.

The assessment of cervical disease in patients with rheumatoid arthritis can be difficult due to co-existing systemic illness and neurological abnormalities and rheumatoid polyarthropathy. Most schemes to assess myelopathy require a relatively normal musculoskeletal system. The Ranawat scale is often used to grade rheumatoid myelopathy because its coarse grading structure accepts the major musculoskeletal disability related to the rheumatoid polyarthropathy that these patients suffer from.

For the purposes of this study, we have modified it to exclude pain and clarify mild changes secondary to spinal cord compression. Asymptomatic hyper-reflexia and sensory symptoms have been separated as only the latter is symptomatic and the reduction of sensory symptoms is of clear benefit to the patient. Our modification of the Ranawat scale has the potential, therefore, to demonstrate real clinical improvement which may otherwise not be documented.

Occipital neuralgia may relate to C1 and C2 nerve entrapment. Cranial nerve changes are probably due to nuclei compression within the brainstem when vertebral migration of the odontoid peg occurs and pyramidal tract compression produces long tract signs. Cruciate paralysis with the differing levels of decussation of the pyramidal tracts may well explain significant weakness of the arms whilst leg motor function is preserved. This certainly mirrored the pattern of presentation of rheumatoid myelopathy (Modified Ranawat grade 3b) sometimes observed. In addition, cord compression of the lower cervical spine may lead to a central cord injury pattern of loss, again with upper limb motor functional loss being more marked than lower limb motor loss.

Boden *et al.* [10] have noted that there is a poor correlation between certain radiological measurements and neurological changes. This occurs because the anterior odontoid interval and percentage spondylolisthesis or SAS are measured, rather than emphasis on the space available for the cord in the upper cervical spine and the subaxial spine. Similarly, vertical migration of the odontoid is difficult to assess on plain radiographs, and MRI is probably the best modality to document and quantify the magnitude of this deformity. When gross destruction has occurred, the interpretation of plain radiographs can be difficult. This was highlighted by the one case in our series where surgery was performed at the wrong level, despite the use of an intra-operative localizing radiograph.

Attempts have been made to predict clinical outcome from radiographic measurements. It has been suggested that a reduction in the posterior dens interval is a more relevant radiological parameter than the changes in the anterior space. Boden *et al.* [10] noted that a posterior dens interval (PDI) of < 10 mm was associated with high mortality, yet five of the patients in our study did well despite this pre-operative degree of canal compromise. Several authors have noted that in the

subaxial spine, the SAC should be at least 13 mm to achieve a good outcome [10, 11]. Despite this observation, three of our patients had measurements of 8 mm.

The indications for surgery are well established in the symptomatic patient. Severe pain may be alleviated and neurological deterioration may be halted and reversed. Controversy still exists, however, over the role of prophylactic procedures in the asymptomatic patient, although early fusion is recommended for gross instability or severe VMO [12].

The underlying pathology of rheumatoid disease dictates the outcome of surgical intervention. The destructive effects of pannus in the presence of osteoporosis lead to poor bone quality and vertebral collapse which can compromise anterior fixation techniques [7]. Similarly, joint destruction of the lateral masses may limit lateral mass fixation techniques in the rheumatoid patient. The neurological outcome following satisfactory stabilization may be unpredictable due to irreversible spinal cord damage, failure to incorporate the area of subluxation or the development of a pseudoarthrosis. Vascular insufficiency and the presence of intermittent compression in the region of instability have also been implicated in the pathogenesis of rheumatoid myelopathy [13]. The latter may explain the successful relief of neurological changes by fusion alone.

The transoral route for odontoid resection has been described with some success by Crockard *et al.* [14] when cord or brainstem compression by the odontoid has occurred. The incidence of complications with this procedure is significant [10], including a risk of mortality, cord damage and neurological deterioration and vertebral artery laceration. Satisfactory results using posterior stabilization alone in our series suggest that this technique may often not be necessary. Stanley *et al.* [13] have echoed this opinion.

We found that posterior stabilization has been both satisfactory and safe, and our experience has led to modifications of established surgical techniques. Although Ransford described the use of only two wires into the occiput, we feel that four wires increased stability of the fixation. Magerl screws have been shown in mechanical studies in cadavers to be the best form of fixation at the atlantoaxial level [15] and we favour this technique for instability at this level, although care must be taken to examine the path of the vertebral artery in the body of C2 when passing the screws. If difficulty achieving safe screw passage through C2 is envisaged and the odontoid peg is intact, then posterior wire techniques with bone grafting and adequate postoperative immobilization are preferred.

The double layer of cortical bone of the laminae provides potentially better fixation for the attachment of wires than the porotic lateral mass. Even then we observed wire cut-out when tightening through porotic laminae on two occasions. Sublaminar wires are a potential danger due to encroachment within the spinal canal and care must be taken to ensure that there is ample space for wire passage. This may involve skipping a level and extending the fusion. Clearly, extension

of instrumentation and fusion is also indicated when laminectomy has been performed. Moskovich and Crockard [16] have advocated the use of a clamp to avoid sublaminar wire passage, although clamp detachment has been reported. Despite these potential technical problems, stability without complication was obtained in most cases. In the single case where stability was not produced (with posterior wire fixation at C1/C2), pain relief still occurred and the patient was satisfied with the outcome. In cases where laminectomy had been performed, a wire mesh was created between limbs of the Ransford loop or Hartshill rectangle to allow bone to be placed posterior to the midline. These rigid fixation techniques allowed early mobilization with limited use of cervical orthoses.

Because of the difficulties of assessing fusion on a radiological basis, stability rather than fusion has been documented. Stability was accepted if no change of position occurred once the construct was established or if no failure of instrumentation occurred. Stability was achieved in all but one of the patients, although we observed resorption of bone graft mass in three patients. In each of these patients, there was a radiological appearance of progressive anterior fusion during the time of the posterior bone graft resorption. Zoma *et al.* [9] noted solid fusion in only 57% of 32 rheumatoid patients, although symptomatic relief did not appear to be closely related to the presence of a radiographic fusion.

The posterior approach has a predictable outcome with acceptably low complication rates, yet stabilization can still be difficult to achieve. Failure to achieve long-term success may result from subluxation at adjacent levels, pseudarthrosis, angulation, and lateral joint collapse resulting in vertical migration of odontoid peg despite posterior stability. Furthermore, stabilization of vertebral segments may predispose to accelerated instability at other levels due to increasing load upon adjacent rigid segments [17]. This is a major concern where long fusions are employed; however, the two cases demonstrating progression of SAS in this series occurred later after isolated C1/C2 fusion. It is conceivable that the advanced age of most patients, along with the limited activity due to the rheumatoid disease, may protect adjacent segments from clinically relevant destruction and deformity.

The relief of upper cervical neck pain, occipital neuralgia, headache and facial pain in our patients was encouraging and rewarding. Some residual lower cervical discomfort can persist in patients with long fusions above areas with degenerate change and rheumatoid involvement.

We conclude that posterior surgical stabilization of the rheumatoid cervical spine can provide effective relief of neck pain and lead to progressive neurological improvement. The complications encountered in this

series highlight the need for careful attention to detail when performing cervical fusion in patients with rheumatoid arthritis.

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