

Occipital Condyle Fractures

RECOMMENDATIONS

DIAGNOSTIC:

Standards: There is insufficient evidence to support diagnostic standards.

Guidelines: Computed tomographic imaging is recommended for establishing the diagnosis of occipital condyle fractures. Clinical suspicion should be raised by the presence of one or more of the following criteria: blunt trauma patients sustaining high-energy craniocervical injuries, altered consciousness, occipital pain or tenderness, impaired cervical motion, lower cranial nerve paresis, or retropharyngeal soft tissue swelling.

Options: Magnetic resonance imaging is recommended to assess the integrity of the craniocervical ligaments.

TREATMENT:

Standards: There is insufficient evidence to support treatment standards.

Guidelines: There is insufficient evidence to support treatment guidelines.

Options: Treatment with external cervical immobilization is recommended.

RATIONALE

Although the traumatic occipital condyle fracture (OCF) was first described by Bell (2) in 1817, more frequent observation of this injury has only been reported during the past 2 decades. Improvements in computed tomographic imaging technology and use of computed tomographic imaging of the head-injured patient that includes the craniovertebral junction have resulted in more frequent recognition of this injury. However, the overall infrequent occurrence of OCF and missed diagnoses in patients with OCF may result in late neurological deficits in these patients. An analysis of the reported cases of OCF may facilitate development of diagnostic and treatment recommendations for this disorder and is undertaken in this chapter. Specific questions that were addressed include the accuracy of plain x-rays and computed tomography (CT) in the diagnosis of OCF and the safety and efficacy of various treatment modalities, including no treatment, traction, external immobilization, decompression, and internal fixation with fusion.

SEARCH CRITERIA

A computerized search of the National Library of Medicine database of the literature published from 1966 to 2001 was undertaken. The medical subject headings "occipital bone" and "fracture" (spinal, cranial, or fracture alone) yielded 1,830 and 33,537 citations, respectively. A subset of 218 citations contained both headings. The references of the articles were reviewed to identify additional case reports. The articles were reviewed using the following criteria for inclusion in diagnosis: human survivors, type of fracture, and tomographic or plain radiographic findings. The articles were also

reviewed using the following criteria for inclusion in treatment: human survivors, type of fracture, management, and outcome. Because fewer than 100 cases of survivors were identified, even single case reports were considered, provided that basic inclusion criteria were met. The observations from the reports were combined because the usual methods for analysis were precluded by the infrequent occurrence of this injury. Forty-seven articles met the selection criteria, providing data on a total of 91 patients. All but two articles contained Class III data of either single case studies or small case series; none contained more than 15 patients. The two exceptions were prospective studies to evaluate the use of clinical criteria in blunt trauma patients to prompt computed tomographic imaging of the cranial base (5, 26). The duration of follow-up in all articles ranged from several weeks to 5 years. The data provided by these reports was compiled and constitute the basis for this guideline. Summaries of the 43 articles most germane to this topic are provided in *Table 15.1*.

SCIENTIFIC FOUNDATION

Diagnosis

Plain x-rays of the cervical spine were obtained in nearly all 91 patients culled from the literature review. Normal imaging was reported in 42 patients. Eight patients had prevertebral soft tissue swelling, only four of whom did not have associated cervical fractures (5, 17, 19, 28, 30, 41). Ten patients with cervical fractures or displacements were described without mention of the presence or absence of soft tissue swelling (3, 4, 16, 25, 31, 35, 40, 41). Three patients had multiple cervical fractures (5, 31). Associated fractures included four atlas, two

Type II odontoid, three axis, two C5 fractures, one each of C3, C6, and C7 fractures, and one unspecified cervical fracture. One patient had atlantoaxial widening, and one had C5–C6 subluxation (16, 41). Only two patients were identified with OCF on plain x-rays of the cranium or cervical spine (21, 44). The results of plain x-rays were not reported in 28 patients, and plain x-rays were not obtained in one patient with an old healed fracture identified by CT (12). The calculated sensitivity of plain x-rays from these reports in the diagnosis of OCF is 3.2% (2 of 62 patients). Because the data were obtained from case reports and small case series of patients known to have OCF, comparison with the findings of plain x-rays in patients without OCF could not be performed. As a result, specificity, positive predictive value, and negative predictive value could not be determined.

The type of fracture was classified according to Anderson and Montesano (1) into Type I (comminuted from impact), Type II (extension of a linear basilar cranial fracture) (20), and Type III (avulsion of a fragment) fractures (*Fig. 15.1*). The 91 patients in this review population provided data on 85 unilateral fractures (12 Type I, 24 Type II, and 49 Type III), 4 bilateral fractures (one Type I, two Type III, and one mixed Type I and Type III), and 2 old fractures.

All but one patient (44) underwent tomographic imaging (6 polytomography alone, 83 computed tomographic imaging alone, and 1 both). One OCF was missed with polytomography and subsequently identified on CT (33). Two patients had OCF diagnosed from retrospective review of computed tomographic images that were initially interpreted as normal (12). The diagnosis of OCF could be made in every patient with OCF. Bloom et al. (5) performed a prospective study during a 1-year period to identify the frequency of OCF in patients meeting certain clinical criteria. Fifty-five consecutive patients with high-energy blunt craniocervical trauma underwent thin-section craniocervical junction computed tomographic imaging. Supplemental criteria included reduced Glasgow Coma Score at admission, occipitocervical tenderness, reduced craniocervical motion, lower cranial nerve abnormality, and retropharyngeal soft tissue swelling. Nine (16.4%) of 55 patients were identified with OCF. Other reports have estimated a 1 to 3% frequency of OCF in patients sustaining blunt craniocervical trauma (24, 31). Similarly, Link et al. (26) reported the results of craniocervical CT on 202 patients with a Glasgow Coma Score between 3 and 6. OCF was identified in 9 (4.4%) of 202 patients.

Loss of consciousness was observed in 36 of 44 patients. Among 64 patients who had a sufficiently detailed neurological examination reported, 25 were normal, 24 had acute or delayed cranial nerve deficits alone, 6 had cranial nerve deficits with limb weakness, 6 had mild to severe limb weakness without cranial nerve deficits, 1 had a delayed onset of vertigo, 1 had hyperreflexia, and 1 had diplopia. Only 4 patients were found who did not have occipitocervical pain in the absence of significantly impaired consciousness (28, 32, 41).

One patient was intoxicated, one had severe extremity pain, and two had severe facial trauma.

Only 11 patients were investigated with magnetic resonance imaging (MRI) (3, 12, 13, 15, 19, 21–23, 41, 42). Early craniocervical MRI was performed in eight patients, and late MRI studies were obtained in three patients. Cervicomedullary hemorrhages were seen in three patients, two had normal imaging, one had a retrodental hemorrhage, one had a torn tectorial membrane, and one had demonstration of the fracture. Displaced fracture fragments were observed in all three patients with delayed MRI. Although early MRI has been infrequently reported after OCF, Tuli et al. (41) proposed a new classification scheme using MRI to differentiate stable from unstable OCF. However, the case example they gave demonstrated concurrent atlantoaxial instability that prompted occipitocervical fusion (rather than atlanto-occipital instability and OCF fracture).

In summary, the diagnosis of OCF is rarely made on plain x-rays. Imaging of the craniocervical junction with CT or other tomographic methods is recommended in patients suspected of having OCF. Blunt trauma patients sustaining high-energy craniocervical injuries may be more likely to sustain OCF. Consequently, cranial imaging should include evaluation of the craniocervical junction. Other clinical criteria, including altered consciousness, occipital pain or tenderness, impaired craniocervical motion, lower cranial nerve paresis, or retropharyngeal soft tissue swelling, should prompt computed tomographic imaging of the craniocervical junction.

Treatment

Twenty-three patients (2 Type I, 14 Type II, 5 Type III, 2 unknown type) did not receive treatment (6, 9, 12, 13, 18, 31, 33, 34, 41, 42, 44, 45). Nine of these patients (one Type I, four Type II, four Type III) developed cranial nerve deficits within days to weeks after injury (6, 9, 12, 13, 31, 33, 34, 42, 45). One hypoglossal nerve palsy resolved, two hypoglossal nerve deficits improved, three other cranial nerve deficits persisted (two hypoglossal, one glossopharyngeal, and one vagal), and three outcomes were not reported. Six additional patients developed delayed deficits or symptoms. Two initially untreated patients (one Type II, one Type III) developed multiple lower cranial nerve deficits that improved after 6 weeks of cervical immobilization (23). Another initially untreated patient (Type III) developed vertigo after 3 months that resolved after 8 weeks of collar immobilization (7). One patient (Type III) developed nystagmus and a lateral rectus palsy after precautionary collar immobilization was discontinued. The deficit resolved after cervical immobilization was resumed (14). One patient (Type III) developed double vision during cervical traction that resolved with surgical decompression (45). Finally, one patient (Type III) developed delayed vagal, spinal accessory, and hypoglossal nerve palsies during cervical immobilization in a cervical collar (8). The Cranial Nerve

TABLE 15.1. Summary of Reports on Occipital Condyle Fractures*

Series (Ref. No.)	Age (yr)/Sex	Type	Location	Pain	Plain X-ray	CT	MRI	Examination	Treatment	Outcome
Legros et al., 2000 (23)	71/F	III	-	Unrep	Unrep	L, +	Epidural	Del CN 6, 7, 10	6 wk collar	18 mo CN 10
	44/M	II	-	Unrep	Unrep	R, +	Normal	Del CN 6, 9-12	6 wk collar	3.5 mo CN 10
Idle et al., 1998 (19)	25/M	III	+	+	STS, C1 Fx	R, +	Tectorial membrane tear	Normal	10 wk collar	10 wk normal
Demisch et al., 1998 (13)	45/F	II	Unrep	Unrep	Unrep	R, +	Fx	Del CN 12	None	1 yr imp CN 12
Bloom et al., 1997 (5)	21/M	III	Unrep	Unrep	STS, C6, 7 Fx	R, +	Unrep	Normal	>8 wk collar	Normal
	36/F	III	Unrep	Unrep	Unrep	L, +	Unrep	Normal	>8 wk collar	Pain
	15/F	I/I	Unrep	Unrep	Unrep	B, +	Unrep	Qparesis	>8 wk collar	Imp Qparesis
	45/F	III/I	Unrep	Unrep	Unrep	B, +	Unrep	CN 12	>8 wk collar	Pain, CN 12
	22/F	II	Unrep	Unrep	Unrep	R, +	Unrep	Normal	>8 wk collar	Unrep
	21/M	I	Unrep	Unrep	STS, C1, 2, 5 Fx	R, +	Unrep	Normal	>8 wk collar	Unrep
	41/M	I	Unrep	Unrep	Unrep	R, +	Unrep	Normal	>8 wk collar	Normal
	6/F	II	Unrep	Unrep	Unrep	L, +	Unrep	Normal	>8 wk collar	Normal
	25/F	I	Unrep	Unrep	STS, C2 Fx	L, +	Unrep	Normal	>8 wk collar	Unrep
	20/M	I	Unrep	Unrep	C Fx	R, +	Unrep	Pplesia	>8 wk collar	Unrep
Tuli et al., 1997 (41)	64/F	III	Unrep	+	STS	R, +	None	Normal	12 wk collar	3 mo normal
	69/F	III	Unrep	-	AA wide	L, +	Fx	Mparesis, CN	OC fusion	Imp
	27/M	Old	Unrep	-	Normal	L, +	None	Normal	None	3 yr normal
	15/F	I	Unrep	+	Normal	R, +	None	Normal	7 wk Minerva Tr collar	4 mo normal
Cottalorda et al., 1996 (10)	20/F	III	Unrep	Unrep	Normal	R, +	Contusion	Hpa, CN 12	3 mo halo	5 yr imp CN 12
Lam and Stratford, 1996 (22)	62/M	III	Unrep	Unrep	Normal	R, +	Fx	Del CN 9, 10	None	6 mo same
Urculo et al., 1996 (42)	33/M	I	Unrep	Unrep	Unrep	?, +	None	Del CN 12	None	Unrep
Noble and Smoker, 1996 (31)	26/M	I	Unrep	Unrep	Unrep	?, +	None	GCS 15	None	Unrep
	16/M	II	Unrep	Unrep	Unrep	?, +	None	GCS 13	None	Unrep
	32/M	II	Unrep	Unrep	C2 Fx	?, +	None	CN 7, 12	None	Unrep
	53/F	II	Unrep	Unrep	Unrep	?, +	None	GCS 8	None	Unrep
	47/F	II	Unrep	Unrep	Unrep	?, +	None	GCS 15	None	Unrep
	37/M	II	Unrep	Unrep	Unrep	?, +	None	GCS 8	None	Unrep
	11/M	II	Unrep	Unrep	Unrep	?, +	None	GCS 13	None	Unrep
	33/M	II	Unrep	Unrep	Unrep	?, +	None	GCS 15	None	Unrep
	23/M	II	Unrep	Unrep	Unrep	?, +	None	Unrep	Unrep	Unrep
	39/M	III	Unrep	Unrep	II Od Fx	?, +	None	CN 7	Halo	Unrep
	88/M	III	Unrep	Unrep	C1, II Od Fx	?, +	None	GCS 15	Halo	Unrep
	29/M	III	Unrep	Unrep	Unrep	?, +	None	Unrep	Unrep	Unrep
	14/F	III	Unrep	Unrep	Unrep	?, +	None	GCS 11	Collar	Unrep
	17/F	III	Unrep	Unrep	Unrep	?, +	None	GCS 7	None	Unrep
Castling and Hicks, 1995 (9)	21/M	II	+	+	Normal	R, +	None	Del CN 12	None	2 yr normal
Emery et al., 1995 (15)	26/M	III	Unrep	+	Normal	L, +	Fracture	Hyperreflexic	Collar	4 mo normal
Paley and Wood, 1995 (34)	21/M	III	Unrep	+	Normal	L, +	Normal	Del CN 12	None	6 mo imp CN 12
Stroobants et al., 1994 (39)	27/M	III	-	+	Normal	R, +	None	Normal	10 wk collar	21 mo normal
	12/F	III	-	+	C1 Fx	L, +	None	Normal	4 wk Minerva	Normal
Wasserberg and Bartlett, 1995 (45)	39/M	III	+	Unrep	Normal	L, +	None	Del CN 12	None	12
	24/M	III	+	+	Normal	L, +	None	Del diplopia	Decompression	Normal
	16/M	III	+	Unrep	Normal	R, +	None	Brain injury	Collar	3 mo CN 12
	34/M	III	Unrep	Unrep	Normal	R, +	None	Unrep	Halo	Unrep

TABLE 15.1. Continued

Series (Ref. No.)	Age (yr)/Sex	Type	Location	Pain	Plain X-ray	CT	MRI	Examination	Treatment	Outcome
Young et al., 1994 (47)	26/F	III	+	Unrep	Normal	L, +	None	Hpa, CN 9-12	12 wk halo	14 mo imp CN 9-12
Mann and Cohen, 1994 (27)	20/M	III	+	Unrep	Normal	R, +	None	GCS 7	Collar	1 yr Hpa
Olsson and Kunz, 1994 (32)	23/M	III	-	+	Normal	R, +	None	Normal	6 wk collar	Normal
Sharma et al., 1994 (37)	43/M	III	Unrep	-	Normal	L, +	None	Normal	Collar	Normal
Massaro and Lanoite, 1993 (29)	35/M	III	Unrep	Unrep	Normal	L, +	None	CN 9, 10	Decompression	3 mo imp CN 9, 10
Raila et al., 1993 (35)	21/M	III	Unrep	Unrep	Normal	L, +	None	H sensory, CN 12	8 wk Minerva	2 yr CN 12
Bettini et al., 1993 (3)	25/M	III	+	+	Normal	L, +	None	Normal	6 wk collar	Normal
	67/M	III	-	+	C1 abnormal	L, +	None	Normal	Collar	Unrep
	39/F	I	Unrep	+	C3 Fx	L, +	None	Normal	Unrep	Unrep
	24/M	II	+	Unrep	Normal	R, +	None	Normal	Unrep	Unrep
	21/F	III	+	Unrep	Unrep	?, +	Contusion	Coma	Unrep	Unrep
	21/M	III/III	Unrep	+	Normal	B, +	None	Normal	Unrep	Unrep
Leventhal et al., 1992 (25)	42/F	II	+	Unrep	Normal	L, +	None	CN 6, 7	3 mo collar	Unrep
	19/F	III	+	+	Normal	L, +	None	Normal	Collar	Unrep
	43/M	III	Unrep	+	C5 Fx	R, +	None	Normal	Collar	Unknown
	17/F	II	+	Unrep	L1 Fx	R, +	None	GCS 10	3 mo collar	Normal
	36/M	I	+	GCS 8	T1 Fx	R, +	None	GCS 8	3 mo halo	Normal
	17/M	I	+	GCS 4	Normal	R, +	None	GCS 4	3 mo collar	Normal
Mody and Morris, 1992 (30)	21/M	III	+	Unrep	STS	L, +	None	Unrep	6 wk collar	18 mo no symptoms
Bozboga et al., 1992 (7)	34/F	III	+	+	Normal	L, +	None	L Hpa, diplopia	Late decompression	4 yr normal
	37/M	III	+	Unrep	Unrep	L, +	None	Del vertigo	Del 8 wk collar	3 yr normal
Bridgman and McNab, 1992 (8)	32/M	III	+	+	Normal	L, +	None	Del CN 10-12	Collar	1 yr imp CN 10-12
Wani et al., 1991 (44)	67/M	II	+	Unrep	+ Cond fx	L, none	None	CN 9-12	None	CN 10, 12
Wessels, 1990 (46)	26/M	III	+	+	Unrep	R, +	None	CN 7-12	Collar	6 wk imp CN 7-12
	7 mo/M	II	+	Unrep	Unrep	L, +	None	CN 5, 7-12	Collar	4 mo CN 7-12
	27/M	II	+	Unrep	Unrep	R, +	None	CN 7-12	Collar	6 wk imp
Mariani, 1990 (28)	30/M	III	+	-	STS	R, -	None	Normal	8 wk collar	Normal
Jones et al., 1990 (21)	43/M	III/III	+	Unrep	+ Cond Fx	B, +	Contusion	Qplegia	OC Fx	4 wk Qplegia
Desai et al., 1990 (14)	33/M	III	-	+	Normal	L, +	None	CN 6	Collar	4 mo normal
Valaskatzis and Hammer, 1990 (43)	19/M	III	+	+	Normal	R, +	None	Normal	6 wk collar	Normal
Orbay et al., 1989 (33)	37/M	III	Unrep	+	Normal	L, + (tomo -)	None	Del CN 12	None	15 mo CN 12
Savolaine et al., 1989 (36)	71/F	III	+	+	Normal	R, +	None	Hplegia, CN 6	Tr, halo	LM paresis
Anderson and Montesano, 1988 (1)	3/M	I	+	Unrep	Normal	R, +	None	Uncon	Soft	24 mo normal
	18/F	III	+	Unrep	Normal	?, +	None	Unrep	Minerva	36 mo
	22/M	III	+	Unrep	Normal	R, tomo +	None	Uncon	Halo	12 mo normal
	23/M	III	+	Unrep	Normal	L, +	None	Uncon	Collar	Death
	25/M	III	+	Unrep	Normal	?, tomo +	None	Unrep	Minerva	17 mo
	37/M	II	+	Unrep	Normal	L, +	None	Uncon	Collar	12 mo normal
Curri et al., 1988 (11)	16/F	III	+	Unrep	Normal	R, +	None	Decerebrate	Collar	6 mo unrep
Hashimoto et al., 1988 (18)	71/M	II	-	Unrep	Normal	L, +	None	CN 9-12	None	6 mo CN 9-12
Deeb et al., 1988 (12)	25/F	II	Unrep	Unrep	Normal	Del L, +	None	CN 12	None	Unrep
	66/F	Old	Unrep	+	None	Del L, +	Fx	Normal	None	Unrep
Spencer et al., 1984 (38)	19/M	I	+	GCS 8	Normal	L, +	None	GCS 8	Collar, halo	BCN 9, 10
Goldstein et al., 1982 (16)	24/F	III	Unrep	+	C 5, 6 slx	L, tomo +	None	Normal	2 mo collar	Normal
Harding-Smith et al., 1981 (17)	18/M	III	+	Unrep	STS	R, tomo +	None	Uncon	Collar	16 mo normal
Bolender et al., 1978 (6)	23/M	III	Unrep	Unrep	Normal	R, tomo +	None	CN 9-12	None	Unrep
	22/M	II	Unrep	Unrep	Normal	R, tomo +	None	Del CN 6, 9, 10	None	Unrep

^a CT, computed tomography; MRI, magnetic resonance imaging; Unrep, unreported; Del, delayed; +, done or positive; -, not done or negative; Fx, fracture; Imp, improvement; STS, soft tissue swelling; C, cervical; AA, atlantoaxial; Q, quadri-; P, para-; M, mono-; OC, occipital condyle; CN, cranial nerve; GCS, Glasgow Coma Scale; Od, odontoid; L, left; R, right; B, bilateral; tomo, tomography; Tr, traction; Uncon, unconfirmed; Hpa, hemiparesis; Cond, condylar; slx, subluxation.

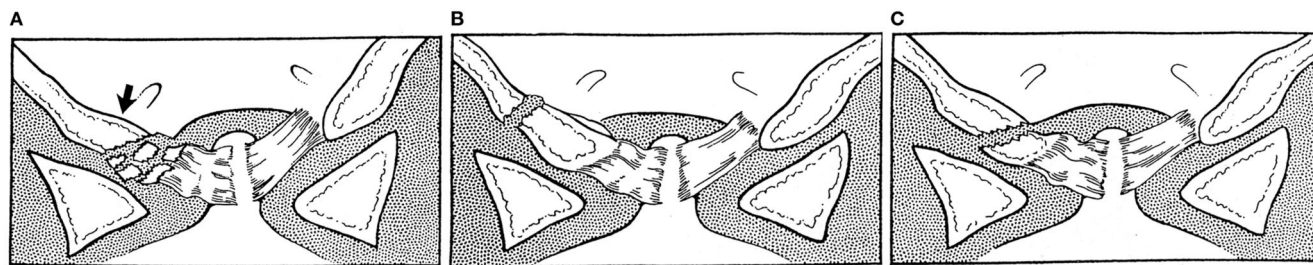


FIGURE 15.1. Classification of occipital condyle fractures according to Anderson and Montesano (1). *A*, Type I fractures may occur with axial loading. *B*, Type II fractures are extensions of a basilar cranial fracture. *C*, Type III fractures may result from an avulsion of the condyle during rotation, lateral bending, or a combination of mechanisms.

X and XI palsies improved. However, the hypoglossal palsy persisted at 1 year.

Forty-four patients were treated with cervical collar immobilization (8 Type I, 8 Type II, 28 Type III) (1, 4, 5, 7, 8, 10, 11, 14–17, 19, 23, 25, 27, 28, 30–32, 35, 39, 41, 43, 45, 46). Thirteen patients were treated with halo/Minerva immobilization (2 Type I, 11 Type III) (1, 22, 25, 29, 31, 36, 38, 40, 45, 47). Treatment was unreported in six patients (3, 31). Five patients (one Type II, four Type III) underwent surgery. Two patients with Type III OCF were treated with occipitocervical fusion (one with concurrent atlanto-occipital dislocation and one with atlantoaxial instability) (21, 41). One patient (Type III) with delayed diplopia had symptom resolution after removal of the fracture fragment (45), whereas one patient (Type II) with lower cranial nerve deficits (37) and one (Type III) with diplopia and hemiparesis (7) remained unchanged several days after surgery. The latter patient subsequently recovered normal function.

In summary, 12 of 15 patients who developed delayed symptoms or deficits were not initially treated. Only 3 of these 12 patients were subsequently treated with cervical immobilization. All three improved. In comparison, only three of six patients demonstrated improvement in deficits without treatment. Only one patient (Type III) developed a deficit during treatment that persisted (hypoglossal nerve palsy) despite collar use. Only three patients underwent surgery for decompression of the brainstem, one of whom had immediate and lasting improvement in symptoms postoperatively. Because 12 of 23 patients developed delayed deficits without treatment and another developed a deficit after premature discontinuation of treatment, the literature suggests that patients with Type III OCF should be treated with external immobilization. Treatment of patients with OCF Types I and II may include external immobilization.

SUMMARY

OCF is an uncommon injury requiring computed tomographic imaging for diagnosis. Patients sustaining high-energy blunt craniocervical trauma, particularly in the setting of loss of consciousness, impaired consciousness, occipitocervical pain or motion impairment, and lower cranial nerve deficits, should undergo computed tomographic imaging of the craniocervical junction. Untreated patients with OCF often

develop lower cranial nerve deficits that usually recover or improve with external immobilization. Identification of Type III OCF should prompt external immobilization. Additional treatment may be dictated by the presence of associated cervical fractures or instability.

KEY ISSUES FOR FUTURE INVESTIGATION

Although Type III OCF is considered by many authors to be unstable, not all patients, treated or not, developed neurological deficits. Computed tomographic imaging with three-dimensional reconstruction for more precise measurement of the magnitude of fracture displacement and MRI for differentiation of partial and complete ligamentous injuries may be useful in identifying subgroups of patients who do not require treatment or, conversely, require more rigid halo immobilization, rather than collar immobilization. Because OCF injuries remain relatively infrequent, cooperative retrospective collection of plain x-ray, computed tomographic, and MRI data in patients with OCF is recommended.

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